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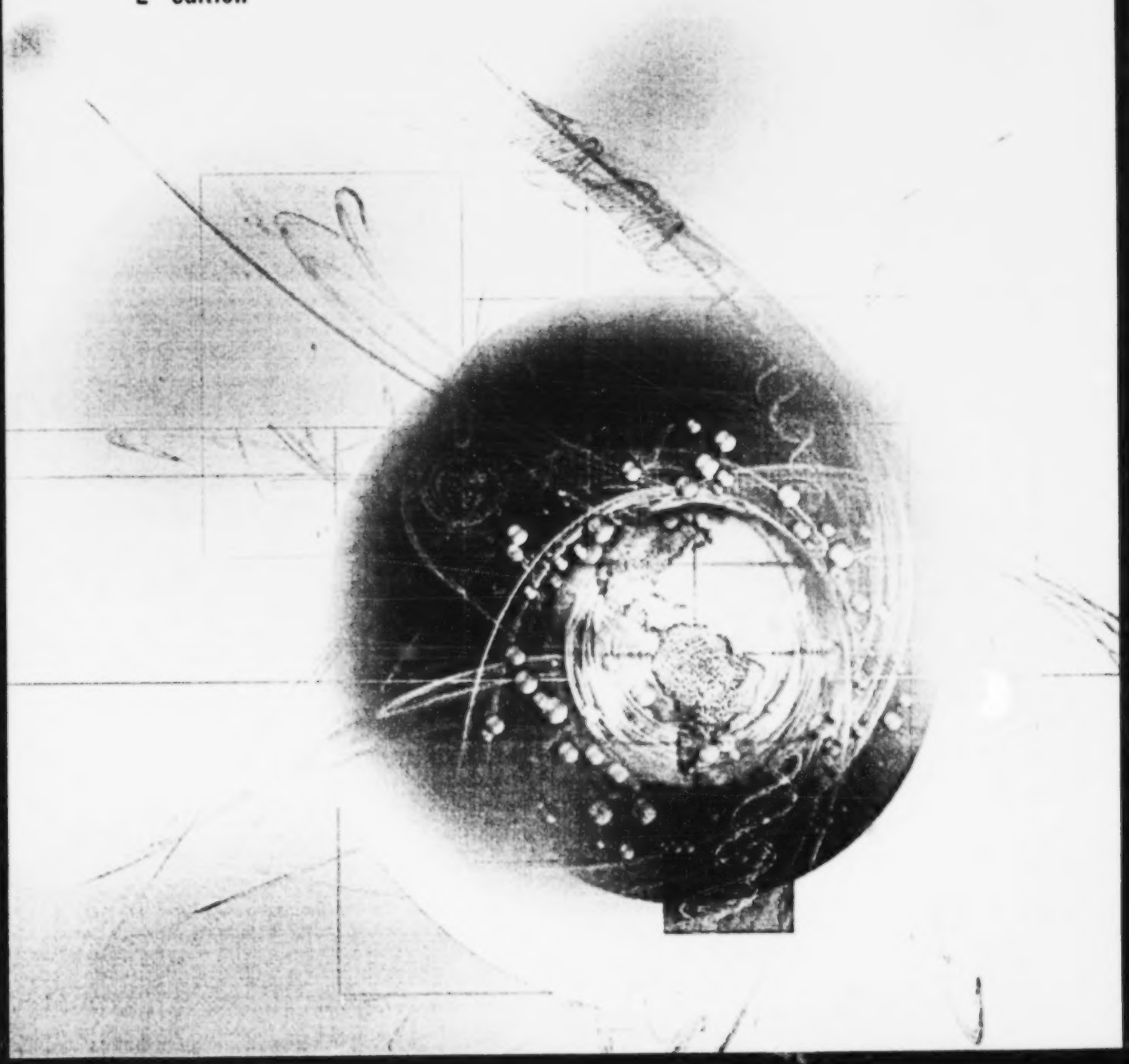
Canada

Canadian Trends in Biotechnology

2nd edition



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This paper was prepared for the Canadian Biotechnology Secretariat by:
Hélène Maheux
Science, Innovation and Electronic Information Division
Statistics Canada

Survey details are available upon request from:
Lara Raoub, Analyst
Science, Innovation and Electronic Information Division
Statistics Canada

Telephone: (613) 951-3490
Fax: (613) 951-9920
E-mail: lara.raoub@statcan.ca

Additional print copies of this paper are available from:
Canadian Biotechnology Secretariat
255 Albert Street, 10th floor
Ottawa, ON K1A 0H5

E-mail: info@biotech.gc.ca

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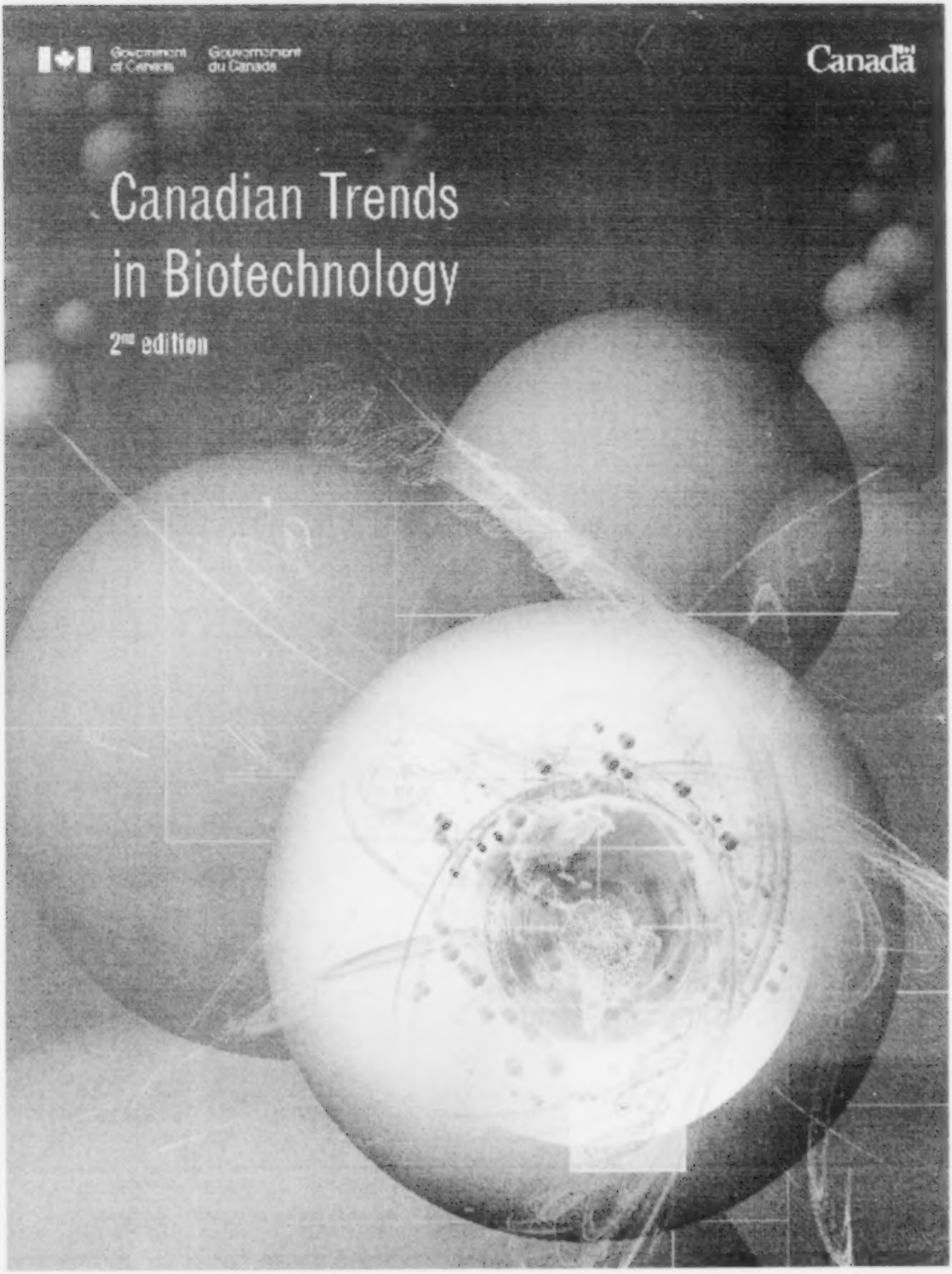
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FOREWORD

Robust and transparent statistical information provides a solid foundation for evidence-based decisions by elected representatives, policy makers, businesses, unions and non-profit organizations, as well as individual Canadians.

In the area of biotechnology, Statistics Canada collects information on federal government expenditures on biotechnology research and development (R&D) and the activities of innovative biotechnology firms, through funding under the Canadian Biotechnology Strategy. Based on those data, this document presents an analysis of trends and changes in government support to R&D and the adoption and development of biotechnology in the business sector in Canada since 1997. The document also places the current state of Canada's biotechnology activities in an international context, by drawing on data from OECD countries.

The Canadian Biotechnology Secretariat and Statistics Canada are pleased to have partnered in the creation and publication of this document, recognizing the need for a consistent and easy-to-use source of information on biotechnology in Canada. The compendium is intended to be a valuable source for analysis and information on the evolving place of biotechnology in Canada.

Kimberly Elmslie
Executive Director
Canadian biotechnology Secretariat

Fred Gault
Director
Science, Innovation and Electronic Information Division
Statistics Canada

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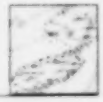
Very special thanks also go to the people who enabled me to obtain additional information for Chapter 2 of this report: Guy Sabourin, Beverley Watier and Yves Morin, for their technical and methodological support, and Lara Raoub and Chuck McNiven for writing some sections of the second chapter.

This report was made possible by funding received through the Canadian Biotechnology Strategy.



SUMMARY

This report is a compilation of the main Canadian statistics on biotechnology. It provides a picture of the major Canadian trends in biotechnology since 1997 in three main areas. Chapter 1 covers the federal government's scientific and technological activities in the field of biotechnology. Chapter 2 describes the characteristics of Canadian firms that are innovating in this field. Chapter 3 makes comparisons between Canada and other countries of the OECD.

CHAPTER 1 deals with the Canadian federal government's science and technology expenditures on biotechnology. This chapter is based on a Statistics Canada publication entitled *Biotechnology scientific activities in federal government departments and agencies*. As this publication shows, in fiscal year 2003-2004, federal science and technology (S&T) expenditures for biotechnology totalled $746 million, which represented 8% of all federal S&T expenditures and a 10% increase over 2002–2003. It also shows that close to 95% of the federal S&T spending on biotechnology was dedicated to R&D activities.

CHAPTER 2 is based on the *Biotechnology Use and Development Surveys* that Statistics Canada conducted in 1997, 1999, 2001 and 2003, and provides a picture of trends in key indicators for Canadian innovative biotechnology firms. The analysis covers all of Canada, and the data are classified by company size, biotechnology activity sector, and region or province of location.

Section 1 discusses the *distribution of innovative biotechnology firms* in Canada. In 2003, there were 490 such companies in Canada: 31% more than in 2001 and 74% more than in 1997. The majority were small firms, operating in the Human Health sector, and located in Quebec, Ontario and British Columbia.

Section 2 presents data on the *financial profiles* of these companies, including their revenues, R&D expenditures, exports, imports, capital raising activities and use of tax incentives. From 1997 to 2003, biotechnology revenues more than quadrupled, from $813 million to $3.8 billion. Over the entire period from 1997 to 2003, more than half of biotechnology revenues were received by companies in the Human Health sector. Also, revenues from biotechnology activities have accounted for a growing share of biotechnology firms' total revenues. From 1997 to 2003, this percentage doubled, from 6% to 12%. Over the same period, biotechnology R&D expenditures by these firms tripled, from $494 million to $1.5 billion. In 2003, companies in the Human Health sector accounted for 89% of these expenditures. Among the three size categories, medium-sized biotechnology firms accounted for the largest percentage of biotechnology R&D expenditures both in 2001 (45%) and in 2003 (47%). Among the 490 innovative biotechnology firms surveyed in 2003, 254 had attempted to raise capital, 178 had succeeded in doing so and 53% had reached their financing target. Among the three size categories, small firms accounted for the largest percentage of all capital raised for biotechnology in 2003 (41%). However, that same year, only 49% of all small firms reached their financing targets,

compared with 69% of all medium-sized firms and 70% of all large firms. Lastly, in 2003, 2 out of 3 companies applied for tax incentives under the federal government's Scientific Research and Experimental Development (SR&ED) program. Small firms applied for smaller amounts of incentives than medium-sized and large firms. Among the various biotechnology sectors, Human Health was one where the highest percentage of firms applied for tax credits. Also, on average, companies in this sector applied for larger amounts of tax incentives than companies in the other sectors.

Section 3 focuses on the *human resources* employed by biotechnology firms. Employment figures for these firms have changed considerably from one survey to the next. From 1997 to 1999, though the number of these companies increased and their key financial figures (revenues, R&D, capital, etc.), were on the rise, their number of employees involved in biotechnology-related activities fell by 15%. From 1999 to 2001, this figure rose by 54%, and from 2001 to 2003 it remained virtually unchanged.

Section 4 analyzes the *products and processes in biotechnology firms' development pipeline*. As of 2003, these firms had at least 17,000 products and processes under development and on the market, 5% fewer than in 2001. This decline was attributable to a 17% drop in the number of products and processes in the pre-commercialization stages.

Section 5 deals with the *business relationships* of innovative biotechnology firms, including alliances, contracting out of biotechnology activities to other organizations, and providing services under contract to other organizations.

Section 6 discusses *spin-off firms*. In 2003, of the 490 innovative biotechnology firms in Canada, 175 were spin-offs. Most of these firms (78%) were spun off from universities, 86% of them were small firms, 70% of them were in the Human Health sector and 31% of them were located in Quebec.

CHAPTER 3 examines data from the OECD to provide some *international comparisons* of the number of biotechnology firms (Section 1), government investment in biotechnology R&D (Section 2) and biotechnology patents (Section 3). According to the OECD's data, Sweden is the country with the highest number of biotechnology companies per capita, followed by Switzerland and Canada. Government-funded R&D expenditures on biotechnology vary from one country to the next. Denmark, Canada and New Zealand invested 10% of their total publicly funded R&D budgets in biotechnology in 2000. Lastly, though Canada accounted for 4% of all the biotechnology patents granted by the United States Patent and Trademark Office (USPTO) in 2000 and 3% of all patent applications filed with the European Patent Office (EPO) in 1999, Canada also had, after Korea and New Zealand, the third highest rate of growth in the number of biotechnology patents filed with the EPO between 1990 and 1999. Compared with other OECD countries, Canada also had a high rate of growth in the number of biotechnology patents granted by the USPTO for 1990 to 2000.

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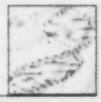

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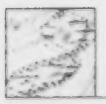


LIST OF STANDARD SYMBOLS

The following standard symbols are used in Statistics Canada tables and graphs:

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0[s]	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
[p]	preliminary
[r]	revised
X	suppressed to meet the confidentiality requirements of the Statistics Act
[E]	use with caution
F	too unreliable to be published

Note: Because of rounding, the totals shown may not always equal the sum of the component values shown.

DEFINITION OF BIOTECHNOLOGY

In general, biotechnology can be defined as "the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services" (OECD, 2005).

The following list of biotechnologies can be used as interpretive guidelines to the single definition. The list is "indicative rather than exhaustive and is expected to change over time as data collection and biotechnology activities evolve" (OECD, 2005).

The list of biotechnology techniques

Bioinformatics:
Construction of databases on genomes, protein sequences; modelling complex biological processes, including systems biology.

Cell and tissue culture and engineerings:
Cell/tissue culture, tissue engineering (including tissue scaffolds and biomedical engineering), cellular fusion, vaccine/immune stimulants, embryo manipulation.

DNA/RNA:
Genomics, pharmacogenomics, gene probes, genetic engineering, DNA/RNA sequencing/synthesis/amplification, gene expression profiling, and use of antisense technology.

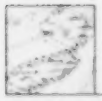
Gene and RNA vectors:
Gene therapy, viral vectors.

Nanobiotechnology:
Applies the tools and processes of nano/microfabrication to build devices for studying biosystems and applications in drug delivery, diagnostics, etc.

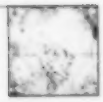
Process biotechnology techniques:
Fermentation using bioreactors, bioprocessing, bioleaching, biopulping, biobleaching, biodesulphurization, bioremediation, biofiltration and phytoremediation.

Proteins and other molecules:
Sequencing/synthesis/engineering of proteins and peptides (including large molecule hormones); improved delivery methods for large molecule drugs; proteomics, protein isolation and purification, signaling, identification of cell receptors.

Source: OECD, "A Framework for Biotechnology Statistics", DSTI/EAS/STP/NESTI(2005)8, Paris, 2005, p. 8.



1 | FEDERAL GOVERNMENT EXPENDITURES ON BIOTECHNOLOGY

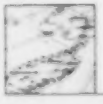


The data in this chapter come from the following sources:

- Statistics Canada, 1998. "Biotechnology scientific activities in selected federal government departments and agencies (1997–1998)", *Science statistics*, vol. 22, no. 4, Catalogue No. 88-001-XIE
- Statistics Canada, 2001. "Biotechnology scientific activities in selected federal government departments and agencies (1999–2000)", *Science statistics*, vol. 25, no. 3, Catalogue No. 88-001-XIE
- Statistics Canada, 2002. "Biotechnology scientific activities in selected federal government departments and agencies (2000–2001)", *Science statistics*, vol. 26, no. 2, Catalogue No. 88-001-XIE
- Statistics Canada, 2003. "Biotechnology scientific activities in selected federal government departments and agencies (2001–2002)", *Science statistics*, vol. 27, no. 1, Catalogue No. 88-001-XIE
- Statistics Canada, 2004. "Biotechnology scientific activities in selected federal government departments and agencies (2002–2003)", *Science statistics*, vol. 28, no. 7, Catalogue No. 88-001-XIE
- Statistics Canada, 2005. "Biotechnology scientific activities in federal government departments and agencies, 2003–2004", *Science statistics*, vol. 29, no. 3, Catalogue No. 88-001-XIE

The information that these publications provide on federal biotechnology-related science and technology (S&T) activities was gathered from the federal departments and agencies most heavily involved in biotechnology. This information includes federal S&T expenditures on biotechnology, which are divided into research and development (R&D) expenditures and expenditures on related scientific activities (RSA).

- For fiscal year 2003–2004, federal S&T expenditures for biotechnology totalled $746 million, or 8% of all federal S&T expenditures. This represented a 10% increase compared with 2002–2003. The bulk of this increase was attributable to four departments and agencies: the Canadian Institutes of Health Research ($39 million), Genome Canada ($31 million), the Natural Sciences and Engineering Research Council of Canada ($9 million) and the Department of National Defence ($5 million).

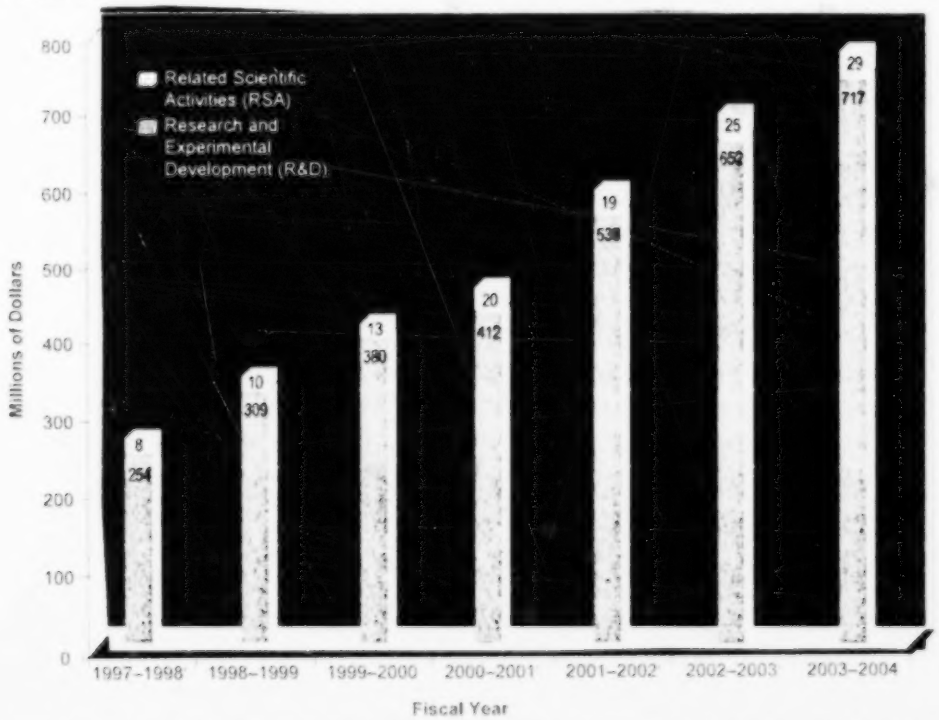


From 1997–1998 to 2003–2004, the average annual rate of growth in federal S&T expenditures on biotechnology was 19%.

Almost all federal biotechnology expenditures (95%) go for R&D activities, and this has been true in every year of the survey.

Most federally funded biotechnology S&T activities were conducted outside the federal government in 2002–2003. The sector that received the greatest percentage of federal biotechnology S&T funding was higher education (51% in 2003–2004, compared with 52% in 1997–1998). This pattern has held true since 1997–1998.

Figure 1
Federal government science and technology expenditures on biotechnology, 1997–1998 to 2003–2004



Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", Science Statistics, Catalogue No. 88-001-XIE.

- From 1997–1998 to 2003–2004, the average annual rate of growth in federal S&T expenditures on biotechnology was 19%.
- Almost all federal biotechnology expenditures (95%) go for R&D activities, and this has been true in every year of the survey.
- Most federally funded biotechnology S&T activities were conducted outside the federal government in 2002–2003. The sector that received the greatest percentage of federal biotechnology S&T funding was higher education (51% in 2003–2004, compared with 52% in 1997–1998). This pattern has held true since 1997–1998.

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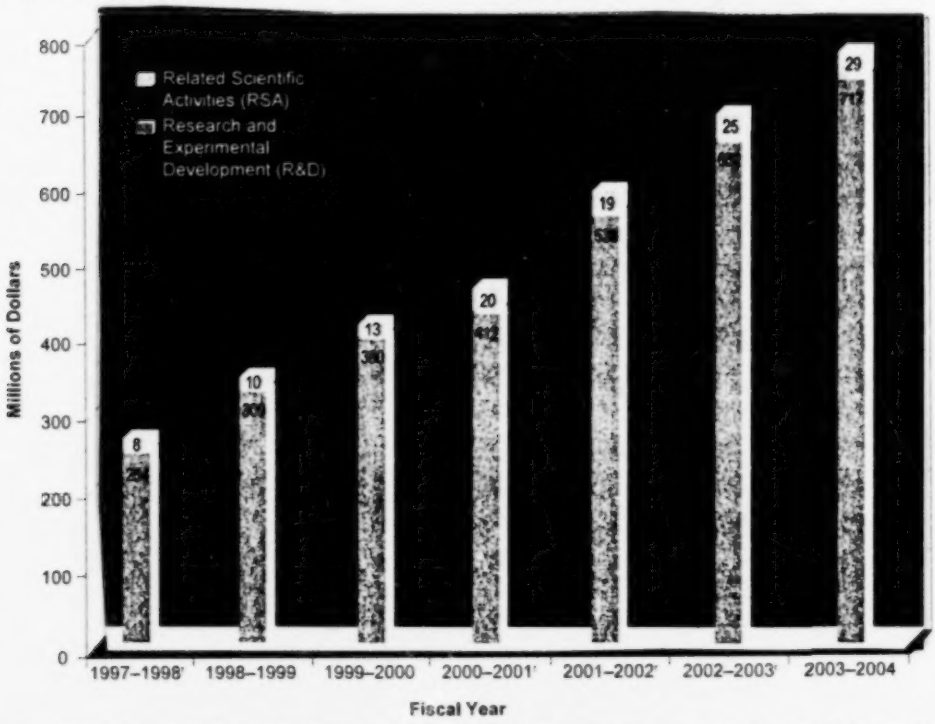
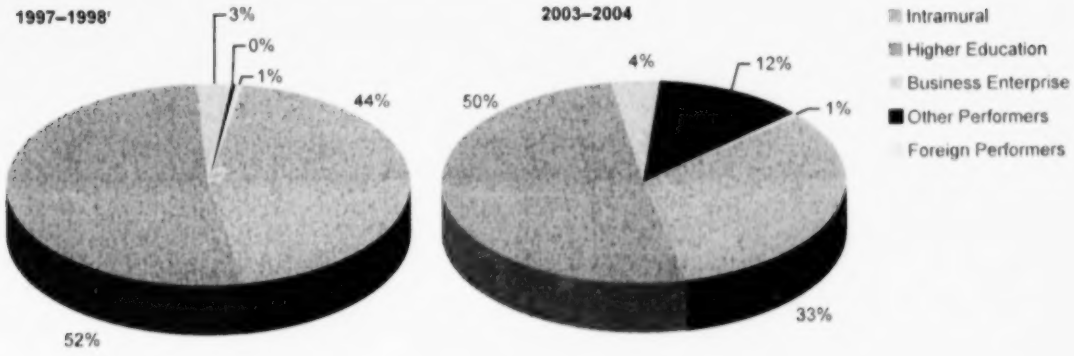


Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE.

Figure 2
Comparison of distributions of federal government science and technology expenditures on biotechnology by performer, 1997–1998 and 2003–2004



Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE.

Table 1
Federal government science and technology expenditures on biotechnology activities, by performer and selected departments and agencies, 1997–1998 to 2003–2004

	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002	2002–2003	2003–2004
	(Thousands of Dollars)						
Performer							
Intramural	116,499	142,964	184,551	193,709	232,764	234,660	243,731
Business enterprise	7,359	16,182	35,499	32,585	33,457	40,313	29,421
Higher education	135,776	156,549	169,159	202,387	206,345	340,096	379,116
Other performers	737	3,016	1,922	2,781	79,887	57,798	88,656
Foreign performers	1,622	766	878	851	4,366	4,810	5,110
Total expenditures	261,993	319,477	392,009	432,312	556,819	677,677	746,034
Department or agency							
Agriculture and Agri-Food Canada	39,890	46,543	55,479	57,227	63,936	63,936	63,936
Canada Foundation for Innovation	...	...	...	33,517	43,915	82,700	78,261
Canadian Institutes of Health Research	...	...	...	133,652	176,406	232,291	271,135
Environment Canada	2,134	1,793	1,389	4,938	1,576	1,748	1,747
Fisheries and Oceans Canada	600	600	2,600	2,251	3,663	3,663	2,916
Genome Canada	...	...	...	...	34,268	50,013	80,701
Health Canada	4,146	3,898	4,798	4,765	7,552	14,369	14,592
Industry Canada	6,296	11,571	32,914	30,425	34,683	36,208	25 690
Medical Research Council	108,020	125,206	133,637	...	...	...	...
National Defence	..	..	..	..	..	8,612	13,850
National Research Council Canada	59,600	83,742	108,630	110,285	130,592	124,772	121 389
Natural Resources Canada	6,291	6,357	7,485	7,914	9,110	6,110	8,537
Natural Sciences and Engineering Research Council of Canada	33,900	38,900	44,000	44,605	48,588	50,339	59,204
Social Sciences and Humanities Research Council of Canada	1,116	921	1,078	2,733	2,530	2,916	4,076
Total expenditures	261,993	319,477	392,009	432,312	556,819	677,677	746,034

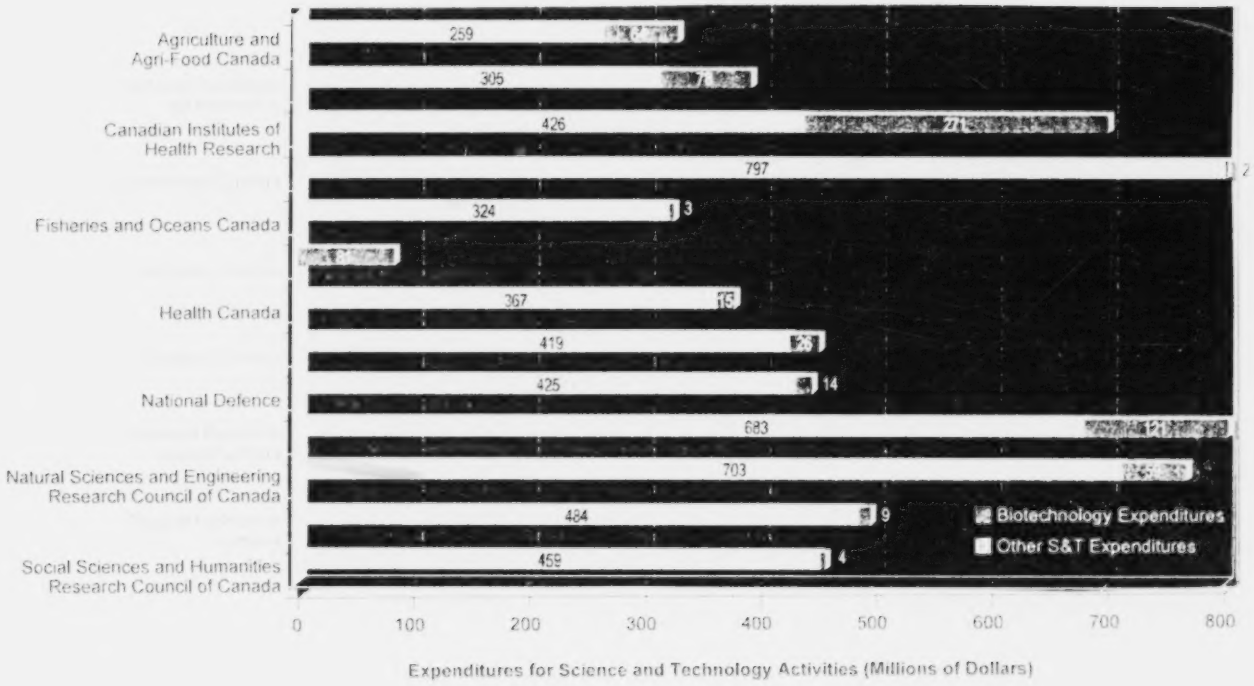
Note: In 2000–2001, the Medical Research Council was replaced by the Canadian Institutes of Health Research.
Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE.

Table 2
Federal government research and development expenditures on biotechnology activities, by performer and selected departments and agencies, 1997–1998 to 2003–2004

	1997–1998	1998–1999	1999–2000	2000–2001[r]	2001–2002[r]	2002–2003[r]	2003–2004
	(Thousands of Dollars)						
Performer							
Intramural	113,074	137,997	177,855	185,027	223,036	229,735	226,513
Business enterprise	6,379	15,141	34,577	25,957	32,881	39,017	28,098
Higher education	132,142	152,468	164,521	197,859	199,034	332,745	370,359
Other performers	507	2,916	1,922	2,693	79,121	56,819	87,412
Foreign performers	1,612	533	628	528	3,785	4,294	4,591
Total expenditures	**253,714**	**309,055**	**379,503**	**412,063**	**537,857**	**662,610**	**716,973**
Department or agency							
Agriculture and Agri-Food Canada	39,881	46,543	55,479	57,227	63,936	63,936	63,936
Canada Foundation for Innovation	...	...	...	33,517	43,915	82,700	78,261
Canadian Institutes of Health Research	...	...	...	133,652	172,912	229,448	268,290
Environment Canada	1,124	1,555	1,222	3,593	1,322	1,224	962
Fisheries and Oceans Canada	580	580	2,600	2,251	2,924	2,924	2,320
Genome Canada	...	...	...	...	34,268	50,013	80,701
Health Canada	2,804	2,556	3,049	3,049	4,988	16,863	7,462
Industry Canada	5,442	8,966	29,008	20,360	29,840	30,619	19,365
Medical Research Council	108,020	125,206	133,637	...	...	...	...
National Defence	..	..	..	..	..	8,150	13,780
National Research Council Canada	58,899	83,027	107,822	108,772	129,177	124,072	118,819
Natural Resources Canada	6,063	5,402	6,779	7,666	8,983	5,181	7,238
Natural Sciences and Engineering Research Council of Canada	30,100	34,600	39,200	39,805	43,359	44,922	52,277
Social Sciences and Humanities Research Council of Canada	801	620	707	2,171	2,233	2,559	3,562
Total expenditures	**253,714**	**309,055**	**379,503**	**412,063**	**537,857**	**662,610**	**716,973**

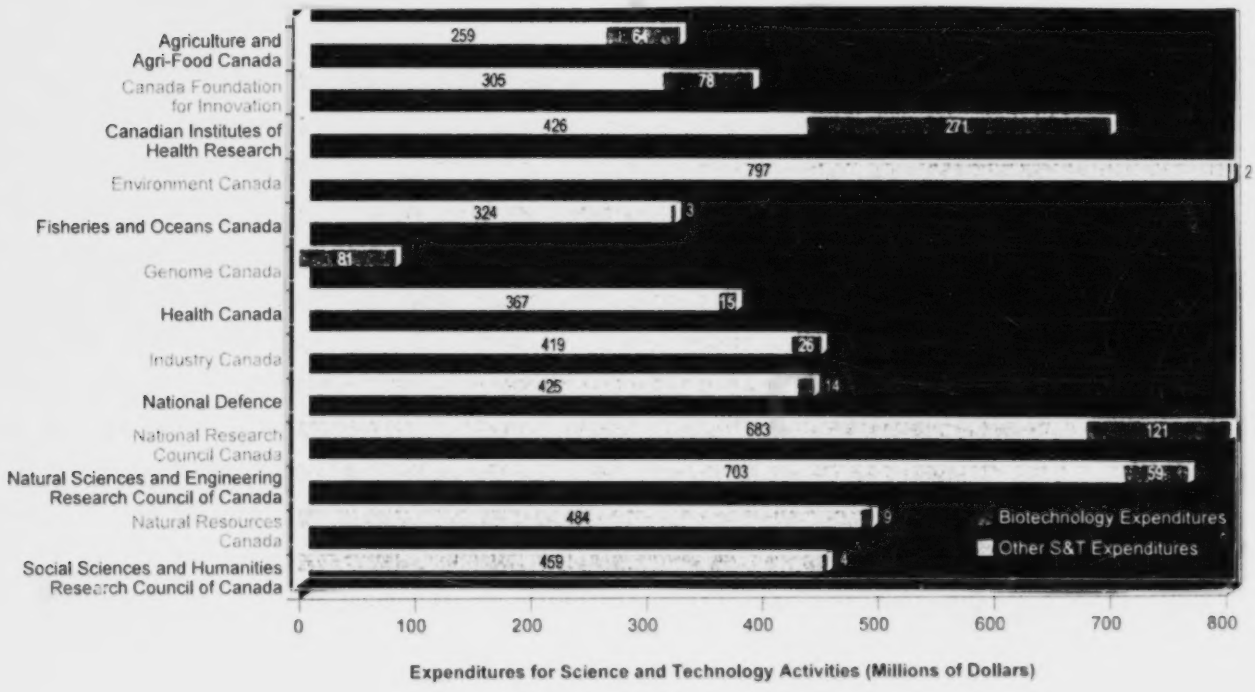
Note: In 2000–2001, the Medical Research Council was replaced by the Canadian Institutes of Health Research.
Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE.

Figure 3
S&T expenditures of selected federal departments and agencies for biotechnology and other activities in S&T, 2003–2004



Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", Science statistics, Catalogue No. 88-001-XIE.

Figure 3
S&T expenditures of selected federal departments and agencies for biotechnology and other activities in S&T, 2003–2004



Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE.

Table 3
Comparison of total expenditures and biotechnology expenditures for selected federal departments and agencies, 2003–2004

	Science and Technology (S&T)			Research and Development (R&D)		
	Total expend. (Thousands of Dollars)	Biotech. expend. (Thousands of Dollars)	Biotech share (%)	Total expend. (Thousands of Dollars)	Biotech. expend. (Thousands of Dollars)	Biotech share (%)
Department or agency						
Agriculture and Agri-Food Canada	322,767	63,936	20	235,508	63,936	27
Canada Foundation for Innovation	383,427	78,261	20	383,427	78,261	20
Canadian Institutes of Health Research	697,513	271,135	39	690,141	268,290	39
Environment Canada	798,920	1,747	0	400,570	962	0
Fisheries and Oceans Canada	327,274	2,916	1	126,291	2,320	2
Genome Canada	80,701	80,701	100	80,701	80,701	100
Health Canada	382,262	14,592	4	123,912	7,462	6
Industry Canada	445,071	25,690	6	383,312	19,365	5
National Defence	439,126	13,850	3	314,890	13,780	4
National Research Council Canada	804,142	121,389	15	728,808	118,819	16
Natural Resources Canada	492,832	8,537	2	274,275	7,238	3
Natural Sciences and Engineering Research Council of Canada	762,065	59,204	8	673,242	52,277	8
Social Sciences and Humanities Research Council of Canada	463,152	4,076	1	407,953	3,562	1
Other	2,589,218	..	..	866,224	..	..
Government of Canada	**8,988,470**	**746,034**	**8**	**5,689,254**	**716,973**	**13**

Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE

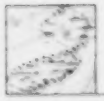


Table 4
Expenditures on biotechnology science and technology activities by selected federal departments and agencies, by performer, 2003–2004

	Intramural	Business enterprise	Higher education	Other	Foreign performers	Total
	(Thousands of Dollars)					
Department or agency						
Agriculture and Agri-Food Canada	**63,936**	**0**	**0**	**0**	**0**	**63,936**
Canada Foundation for Innovation	**2,128**	**0**	**76,133**	**0**	**0**	**78,261**
Canadian Institutes of Health Research	**17,984**	**0**	**242,608**	**6,674**	**3,869**	**271,135**
Environment Canada	**934**	**524**	**216**	**55**	**18**	**1,747**
Fisheries and Oceans Canada	**2,896**	**0**	**10**	**10**	**0**	**2,916**
Genome Canada	**2,465**	**0**	**0**	**78,236**	**0**	**80,701**
Health Canada	**12,598**	**548**	**971**	**370**	**105**	**14,592**
Industry Canada	**6,325**	**19,365**	**0**	**0**	**0**	**25,690**
National Defence	**8,582**	**2,638**	**607**	**2,023**	**0**	**13,850**
National Research Council Canada	**114,710**	**5,589**	**0**	**1,090**	**0**	**121,389**
Natural Resources Canada	**7,901**	**125**	**434**	**53**	**24**	**8,537**
Natural Sciences and Engineering Research Council of Canada	**2,958**	**632**	**54,631**	**0**	**983**	**59,204**
Social Sciences and Humanities Research Council of Canada	**314**	**0**	**3,506**	**145**	**111**	**4,076**
Total expenditures	**243,731**	**29,421**	**379,116**	**88,656**	**5,110**	**746,034**

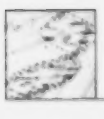
Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science statistics*, Catalogue No. 88-001-XIE.

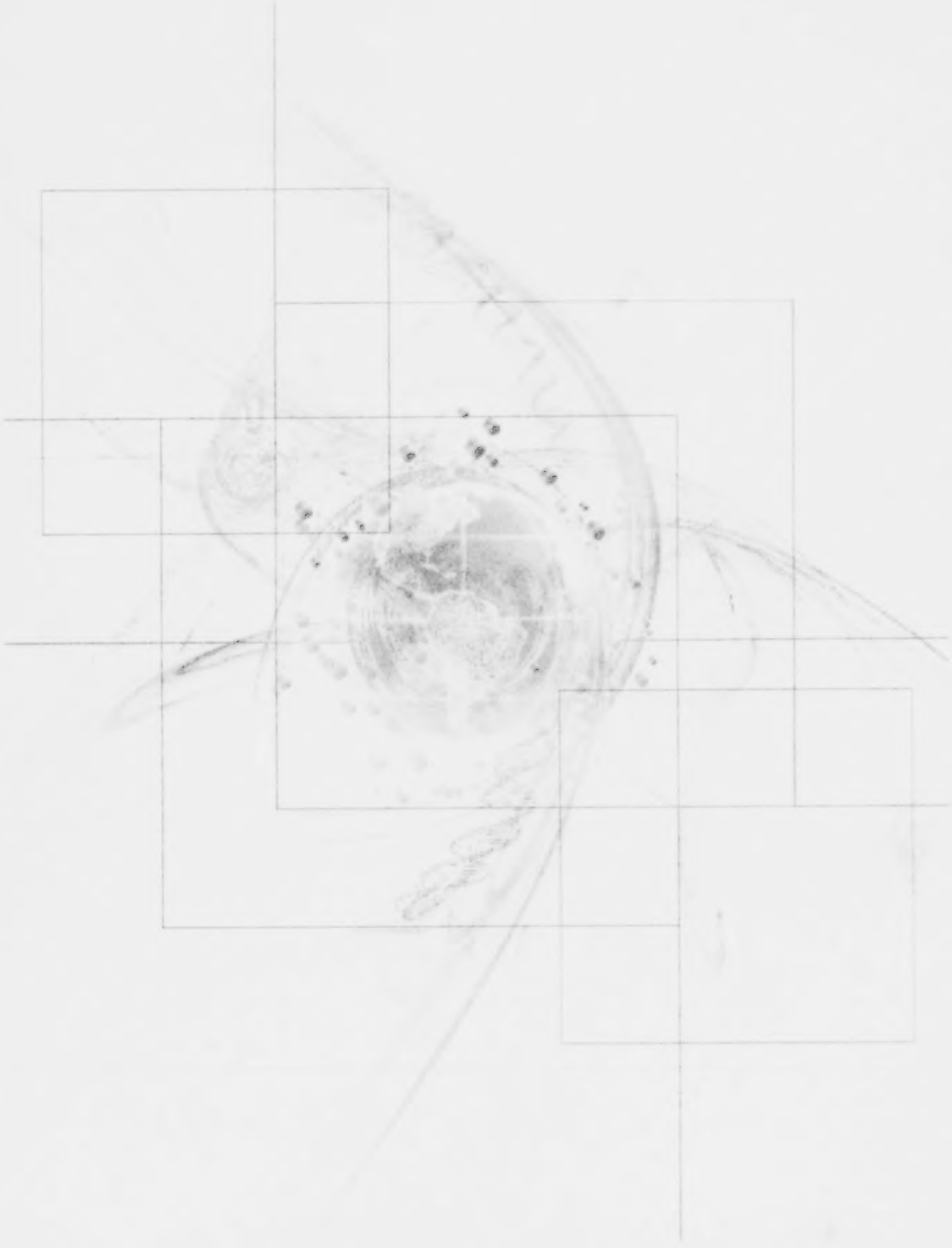
Table 5

Expenditures on biotechnology research and development activities by selected federal departments and agencies, by performer, 2003–2004

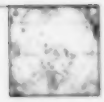
	Intramural	Business enterprise	Higher education	Other	Foreign performers	Total
	(Thousands of Dollars)					
Department or agency						
Agriculture and Agri-Food Canada	63,936	0	0	0	0	63,936
Canada Foundation for Innovation	2,128	0	76,133	0	0	78,261
Canadian Institutes of Health Research	17,410	0	240,431	6,615	3,834	268,290
Environment Canada	691	56	166	31	18	962
Fisheries and Oceans Canada	2,300	0	10	10	0	2,320
Genome Canada	2,465	0	0	78,236	0	80,701
Health Canada	6,274	0	731	352	105	7,462
Industrie Canada	0	19,365	0	0	0	19,365
National Defence	8,512	2,638	607	2,023	0	13,780
National Research Council Canada	113,230	5,589	0	0	0	118,819
Natural Resources Canada	6,702	88	434	0	14	7,238
Natural Sciences and Engineering Research Council of Canada	2,615	362	48,715	0	585	52,277
Social Sciences and Humanities Research Council of Canada	250	0	3,132	145	35	3,562
Total expenditures	**226,513**	**28,098**	**370,359**	**87,412**	**4,591**	**716,973**

Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", Science statistics, Catalogue No. 88-001-XIE.





2 | FEATURES OF INNOVATIVE BIOTECHNOLOGY FIRMS



The population discussed in this chapter consists of "innovative biotechnology firms", previously known as "core biotechnology firms". These are firms that use biotechnology to develop new products or processes.

The data in this chapter come from the following four surveys on biotechnology, which were conducted by Statistics Canada's Science, Innovation and Electronic Information Division.

- *Biotechnology Firm Survey* – 1997
- *Biotechnology Use and Development Survey* – 1999
- *Biotechnology Use and Development Survey* – 2001
- *Biotechnology Use and Development Survey* – 2003

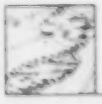
In these surveys, a firm is regarded as innovative if it meets at least one of the following three criteria: it has one or more biotechnology products or processes on the market, it is currently developing products or processes that require the use of biotechnology, or it considers biotechnology central to its activities or strategies.

These four surveys excluded not-for-profit organizations, universities, government laboratories, hospitals, companies that used only traditional methods of biotechnology and companies that provided biotechnology-related services. To minimize the burden on the respondents, the last three surveys (1999, 2001 and 2003) also excluded firms that had fewer than 5 employees and spent less than $100,000 on research and development. This last exclusion should not affect the quality of the data, because these firms contribute very little to biotechnology R&D expenditures, to the number of products in the development pipeline, or to the total human resources employed in biotechnology.

For further details on the methodology of these surveys, see:

- Traoré, N. 2004. *Biotechnology Use and Development Survey: Methodology, Issues and Responses*, Working Paper no. 6, Statistics Canada Catalogue No. 88F0006XIE, Ottawa.
- Raoub et al., 2005. *Overview of the Biotechnology Use and Development Survey – 2003*, Working Paper no. 9, Statistics Canada Catalogue No. 88F0006XIE, Ottawa.

Note: The data from the *Biotechnology Use and Development Survey – 2003* are preliminary and may be subject to revision.



Chapter 2: Features of Innovative Biotechnology Firms

This chapter classifies innovative biotechnology firms according to three criteria: size, sector of activity and region/province of location.

- A firm's **size** is defined according to number of employees. Firms with fewer than 50 employees are classified as small, those with 50 to 149 employees as medium-sized, and those with 150 or more employees as large.
- A firm's **activity sector** is defined as the area of application for which the firm develops the greatest number of biotechnology products or processes. For example, in the 2003 questionnaire, biotechnology firms were grouped into seven sectors (see Table 6). In the present document, for reasons of confidentiality, biotechnology firms are instead grouped into four major sectors: Human Health, Agriculture and Food Processing, Environment, and Other (which includes bioinformatics, aquaculture and natural resources).
- A firm's **geographic location** is defined by the province or territory where it is located. To protect confidentiality, the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador are combined into one group, the Atlantic Region, in this report. All the other provinces are treated individually. No data are available for Canada's three territories (Nunavut, the Yukon Territory and the Northwest Territories).

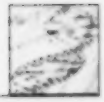
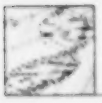


Table 6
Biotechnology activity sectors

Human Health	**Diagnostics** (e.g., biosensors, immunodiagnostics, gene probes)
	Therapeutics (e.g., vaccines, immune stimulants, biopharmaceuticals)
	Drug Delivery
Agriculture Biotechnology	**Plant Biotechnology** (tissue culture, embryogenesis, genetic markers, genetic engineering)
	Animal Biotechnology (e.g., diagnostics, therapeutics, embryo transplantation, genetic markers, genetic engineering)
	Non-food Agriculture (e.g., fuels, lubricants, commodity and fine chemical feedstocks, cosmetics)
Food Processing	**Bioprocessing** (e.g., using enzymes and bacteria cultures)
	Functional Foods/Nutraceuticals (e.g., probiotics, unsaturated fatty acids)
Environment	**Air** (e.g., bioremediation, diagnostics, phytoremediation, biofiltration)
	Water (e.g., biofiltration, diagnostics, bioremediation, phytoremediation)
	Soil (e.g., biofiltration, diagnostics, bioremediation, phytoremediation)
Natural Resources	**Energy** (e.g., microbiologically enhanced petroleum recovery, industrial bioprocessing, biodesulphurization)
	Mining (e.g. microbiologically enhanced mineral recovery, industrial bioprocessing, biodesulphurization)
	Forest Products (e.g., biopulping, biobleaching, biopesticides, tree biotechnology, industrial bioprocessing)
Aquaculture	**Fish health, broodstock genetics, bioextraction**
Bioinformatics	**Genomics and Molecular Modelling** (e.g., DNA/RNA/protein synthesizing and databases for humans, plants, animals, and micro-organisms)
	Gene Therapy (e.g., gene identification, gene constructs, gene delivery)

Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.



SECTION 1
Distribution of Innovative Biotechnology Firms

- In 2003, there were 490 innovative biotechnology firms in Canada, an increase of 31% from 2001 and 74% from 1997. Half of the increase in the number of firms from 2001 to 2003 was attributable to the creation of firms during this period.

- Innovative biotechnology firms tend to be small. In 2003, small firms accounted for almost 75% of all biotechnology companies, while medium-sized firms accounted for 16% and large firms for 12%.

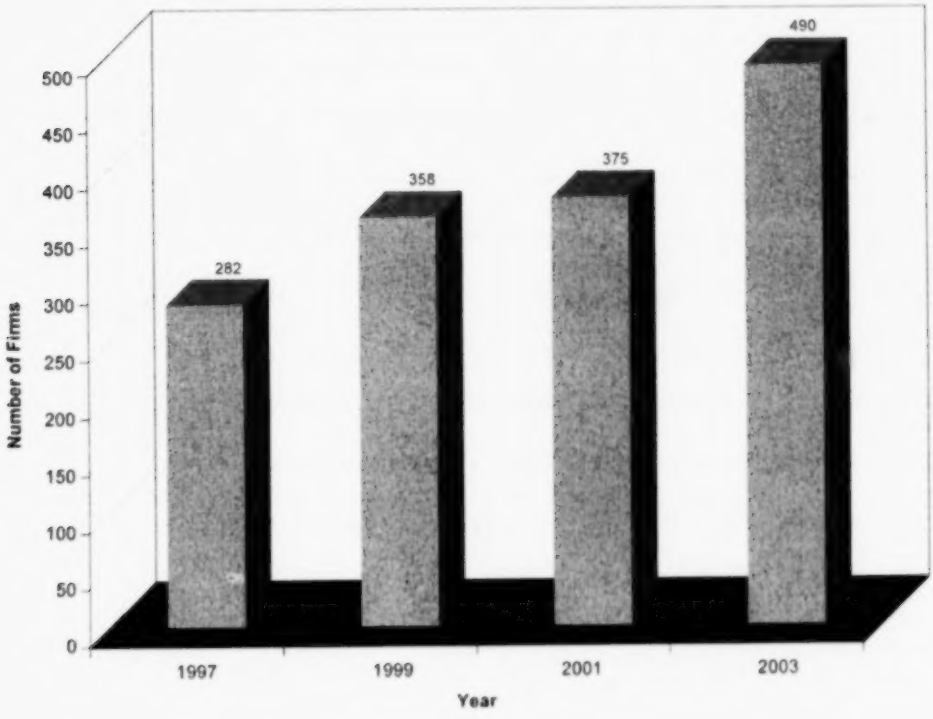
- Innovative biotechnology firms are concentrated mainly in two sectors of activity. In 2003, 51% of these firms were in the Human Health sector and 28% were in the Agriculture and Food Processing sector.

  From 2001 to 2003, the number of biotechnology firms increased in all activity sectors, but the increase was sharpest in the Human Health and in the Agriculture and Food Processing sectors.

- Biotechnology firms are concentrated in three provinces: Quebec, Ontario and British Columbia. Together, these three provinces account for over 70% of all innovative biotechnology firms in Canada. This pattern has persisted throughout the period 1997 to 2003.

  Though the other provinces account for a smaller share of the total number of biotechnology companies in Canada, more and more biotechnology-related activities are taking place in these provinces, and especially in the Prairie provinces (Alberta, Saskatchewan and Manitoba). From 1997 to 2003, the number of innovative biotechnology firms in the Prairie provinces more than doubled, from 44 to 99.

Figure 4
Changes in number of innovative biotechnology firms, 1997 to 2003



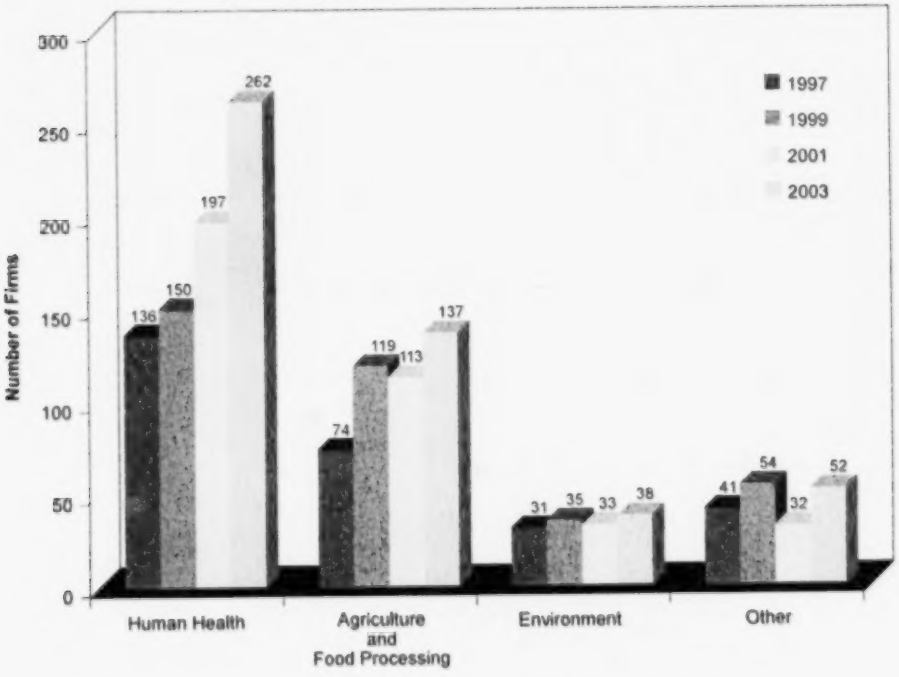
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Table 7
Changes in number of innovative biotechnology firms, by size, sector and province, 1997 to 2003

	Number of firms			
	1997	1999	2001	2003
A) SIZE				
Small	214	270	267	352
Medium	37	51	62	77
Large	31	37	46	61
Total	282	358	375	490
B) SECTOR				
Human Health	136	150	197	262
Agriculture and food processing	74	119	113	137
Environment	31	35	33	38
Other	41	54	32	52
Total	282	358	375	490
C) PROVINCE				
British Columbia	52	71	69	91
Alberta	19	28	24	44
Saskatchewan	19	16	17	34
Manitoba	6	6	11	21
Ontario	87	111	101	129
Quebec	79	107	130	146
Atlantic	20	19	23	25
Total	282	358	375	490

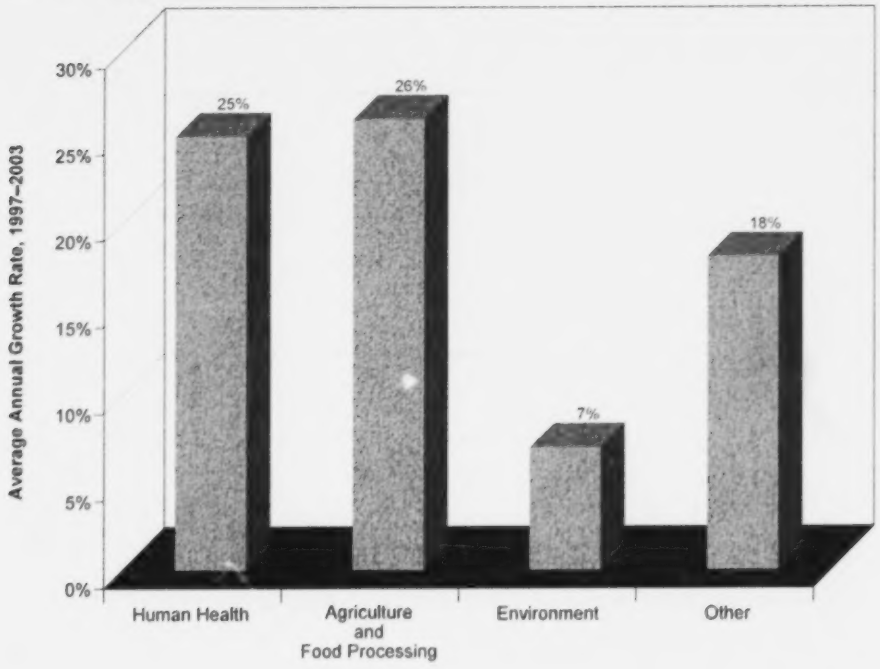
Sources: Statistics Canada, *Biotechnology Use and Development* Survey – 1997, 1999, 2001 and 2003.

Figure 5
Changes in number of innovative biotechnology firms, by sector, 1997 to 2003



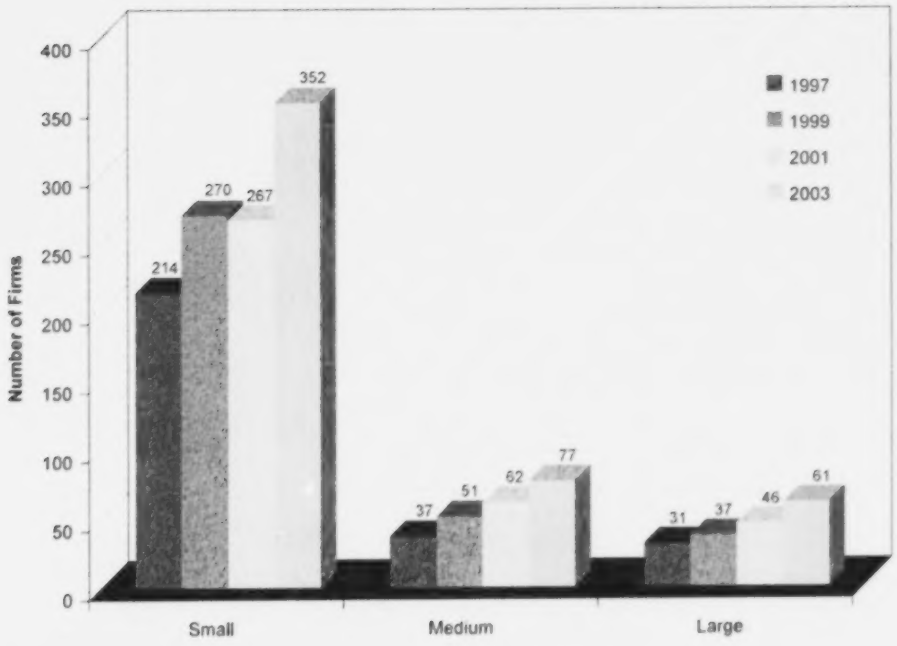
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 6
Average annual rate of growth in number of innovative biotechnology firms, by sector, 1997 to 2003



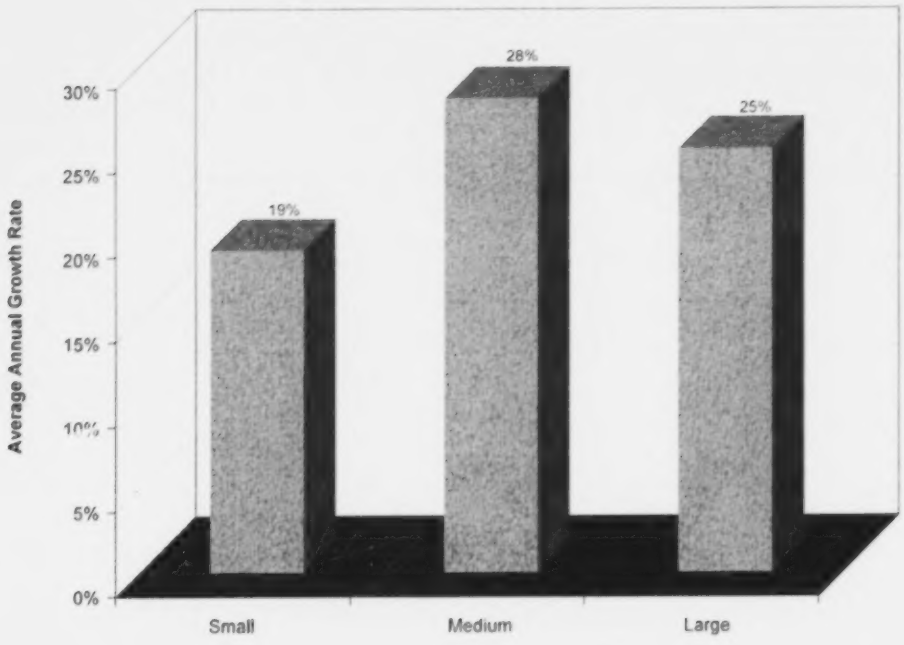
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 7
Change in number of innovative biotechnology firms, by size, 1997 to 2003



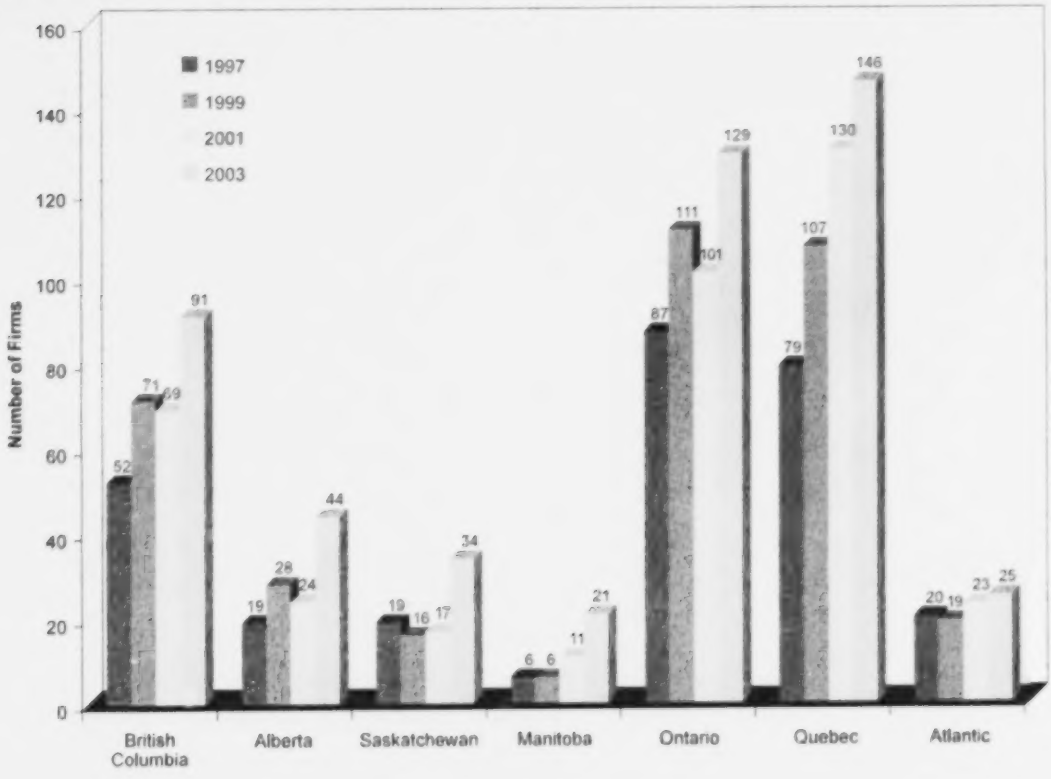
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 8
Average annual rate of growth in number of innovative biotechnology firms, by size, 1997 to 2003



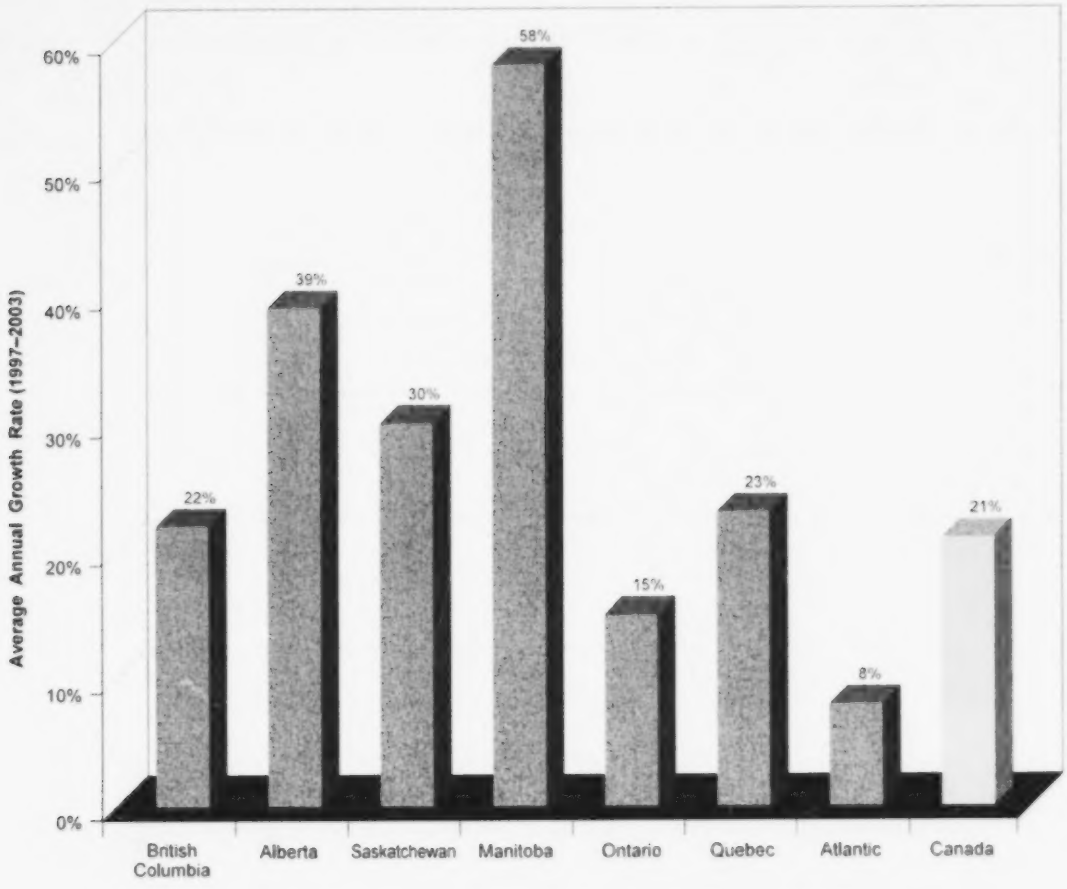
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 9
Changes in number of innovative biotechnology firms, by province, 1997 to 2003



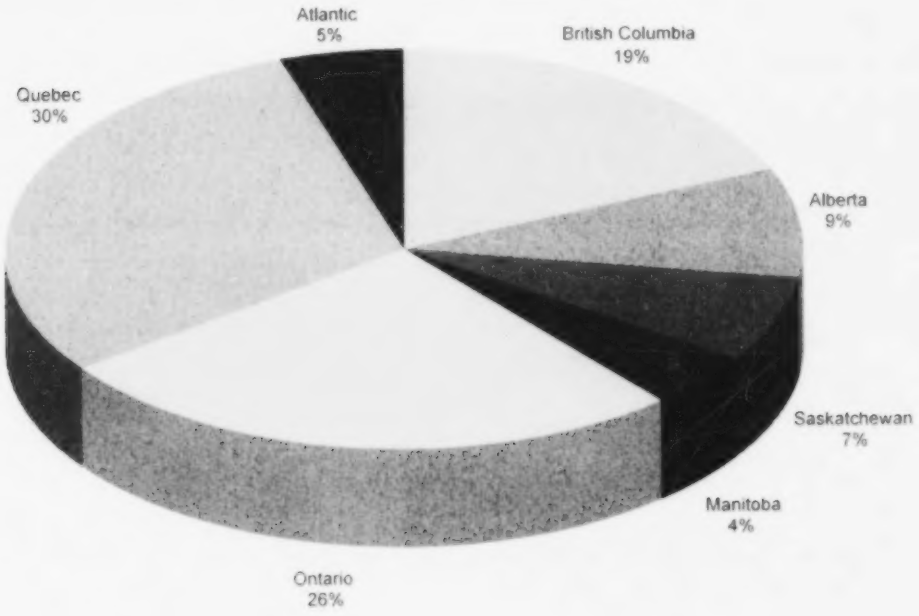
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 10
Average annual rate of growth in number of innovative biotechnology firms, by province, 1997 to 2003



Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 11
Distribution of innovative biotechnology firms by province, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

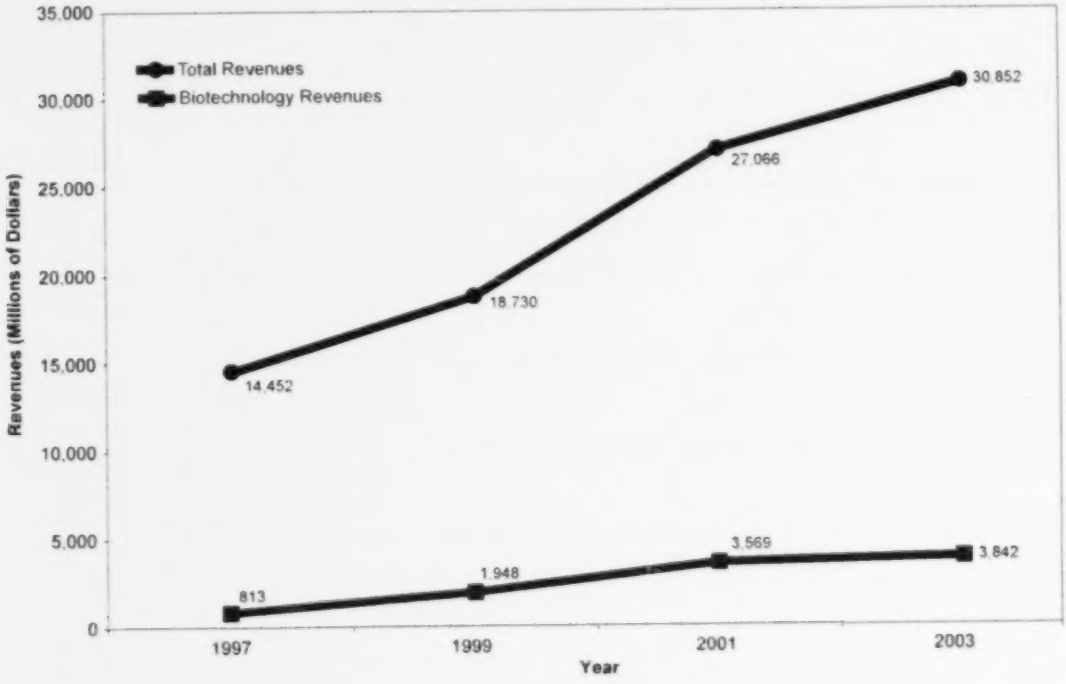
SECTION 2
Financial Profile

2.1 REVENUES

- From 1997 to 2003, the total revenues that innovative biotechnology companies generated from all their activities more than doubled, but the revenues that they generated from their specific biotechnology-related activities more than quadrupled, from $813 million to $3.8 billion.
- Large companies contribute most to total biotechnology revenues in every year of the survey. In 2003, out of the total $3.8 billion in revenues, 64% were generated by large firms, 24% by medium-sized firms and 12% by small firms.
- In 2003, over half of biotechnology revenues were generated in the Human Health sector. This pattern has persisted throughout the period 1997 to 2003. The Agriculture and Food Processing sector generated the second highest level of revenues.
- Ontario companies have contributed the majority of the revenues generated by biotechnology in every year of the survey except 2001, when Quebec claimed first place.

  Together, Ontario, Quebec and British Columbia account for well over half of all revenues generated by biotechnology. In 2003, they accounted for nearly 86% of total biotechnology revenues.
- Biotechnology revenues account for a growing share of biotechnology companies' total revenues, rising from 6% in 1997 to 12% in 2003.
- From 2001 to 2003, biotechnology revenues as a percentage of total revenues remained almost unchanged for medium-sized and large firms, but decreased for small firms, from 45% to 18%.

Figure 12
Changes in total revenues and biotechnology revenues of innovative biotechnology firms, 1997 to 2003



Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Table 8
Changes in biotechnology revenues and total revenues of innovative biotechnology firms, by size, sector, and province, 1997 to 2003

	Biotechnology Revenues (Millions of Dollars)				Total Revenues (Millions of Dollars)			
	1997	1999	2001	2003	1997	1999	2001	2003
A) SIZE								
Small	214	249	521	468	1,756	590	1,169	2,624[E]
Medium	201	295	849	909	685	849	1,504	1,499
Large	398	1,404	2,199	2,465	12,011	17,291	24,392	26,729
Total	813	1,948	3,569	3,842	14,452	18,730	27,066	30,852
B) SECTOR								
Human Health	417	1,036	2,461	1,999	3,397	3,185	5,074	5,972
Agriculture and Food Processing	322	709	826	1,735	9,792	7,153	12,998	6,653
Environment	49	45	268	36	1,090	287	8,900	11,756[E]
Other	25	158	14	72[E]	173	8,105	94	6,472[E]
Total	813	1,948	3,569	3,842	14,452	18,730	27,066	30,852
C) PROVINCE								
British Columbia	47	138	414	779	118	1,880	7,118	4,337
Alberta	56	90	122	298	248	392	132	1,275
Saskatchewan	56	433	21	94	5,644	..	F	3,891
Manitoba	33	69	99	145[E]	1,908	123	759	390[E]
Ontario	363	635	1,376	2,026	2,665	8,121	3,485	11,032[E]
Quebec	224	554	1,515	480	3,805	3,960	10,511	9,708[E]
Atlantic	34	28	22	21	61	..	F	220[E]
Total	813	1,948	3,569	3,842	14,452	18,730	27,066	30,852

Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

2.2 RESEARCH AND DEVELOPMENT EXPENDITURES

- Biotechnology research and development (R&D) expenditures by innovative biotechnology firms tripled over the period 1997 to 2003, from $494 million to about $1.5 billion.

- As a percentage of innovative biotechnology firms' total R&D expenditures, their biotechnology R&D expenditures have increased slightly, from 53% in 1997 to 60% in 2001 and 65% in 2003.

- Medium-sized firms contributed the largest share of biotechnology R&D expenditures in 2001 (45%) and 2003 (47%). Small companies came next.

  In 1999, large companies accounted for 59% of all biotechnology R&D expenditures, but their share fell to 23% in 2001 and 20% in 2003.

  From 2001 to 2003, biotechnology R&D expenditures increased for all sizes of firms except large ones, where these expenditures fell by 3%. However, over this same period, these firms' biotechnology R&D expenditures rose from 34% of their total R&D expenditures to 40%. In other words, despite the decline in their biotechnology R&D expenditures, these companies still devoted a larger share of their total R&D budget to biotechnology.

- Companies in the Human Health sector accounted for nearly 89% of all biotechnology R&D expenditures in 2003. Next, but trailing far behind, came companies in the Agriculture and Food Processing sector, which accounted for 6% of biotechnology R&D that year.

  In the Human Health sector, biotechnology R&D as a percentage of total R&D varied between 70% and 78% for the period of 1999 to 2003. Companies in this sector seem to devote a higher percentage of their R&D investments to biotechnology.

- Ontario and Quebec were the provinces that contributed the largest share of biotechnology R&D expenditures between 1997, 1999 and 2003.

  Though firms in British Columbia contributed the most to biotechnology R&D expenditures in 2001 (31%), their biotechnology R&D expenditures fell by 12% from 2001 to 2003. Despite this decline, biotechnology R&D expenditures accounted for 92% of total R&D expenditures by biotechnology companies in this province in 2003. This indicates that these companies devoted a high proportion of their R&D to biotechnology–higher than in past years.

  Though biotechnology R&D expenditures in Saskatchewan represented only 2% of the Canadian total in 2003, they had doubled since 2001. Over this same period, biotechnology R&D spending as a percentage of total R&D spending by Saskatchewan biotechnology firms rose from 24% to 70%.

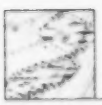
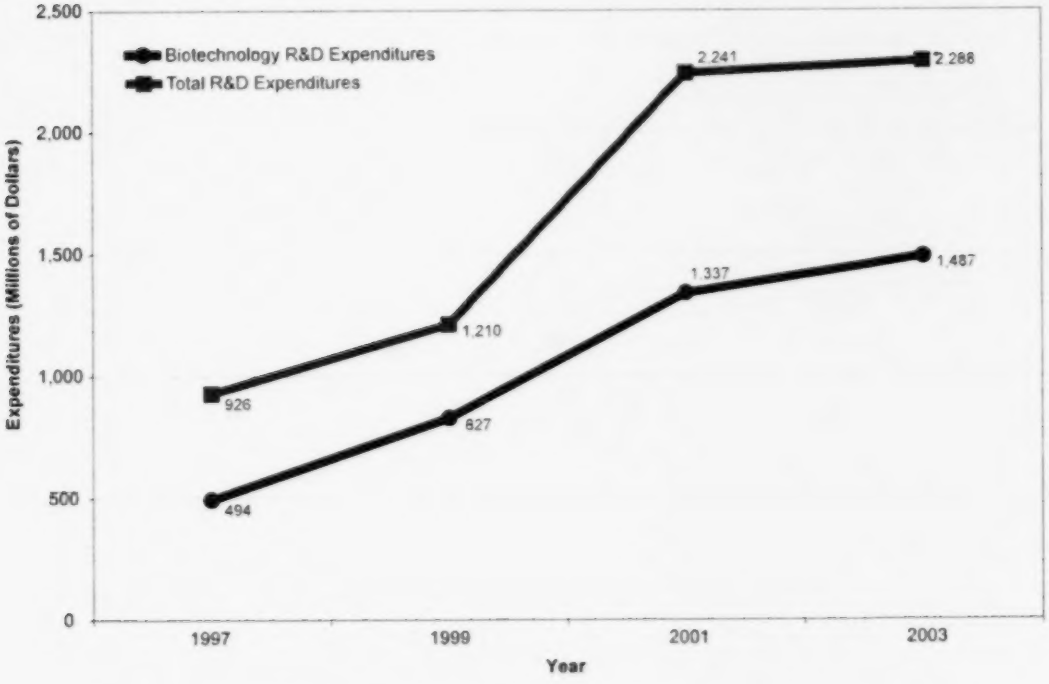


Figure 13
Changes in total R&D expenditures and biotechnology R&D expenditures of innovative biotechnology firms, 1997 to 2003



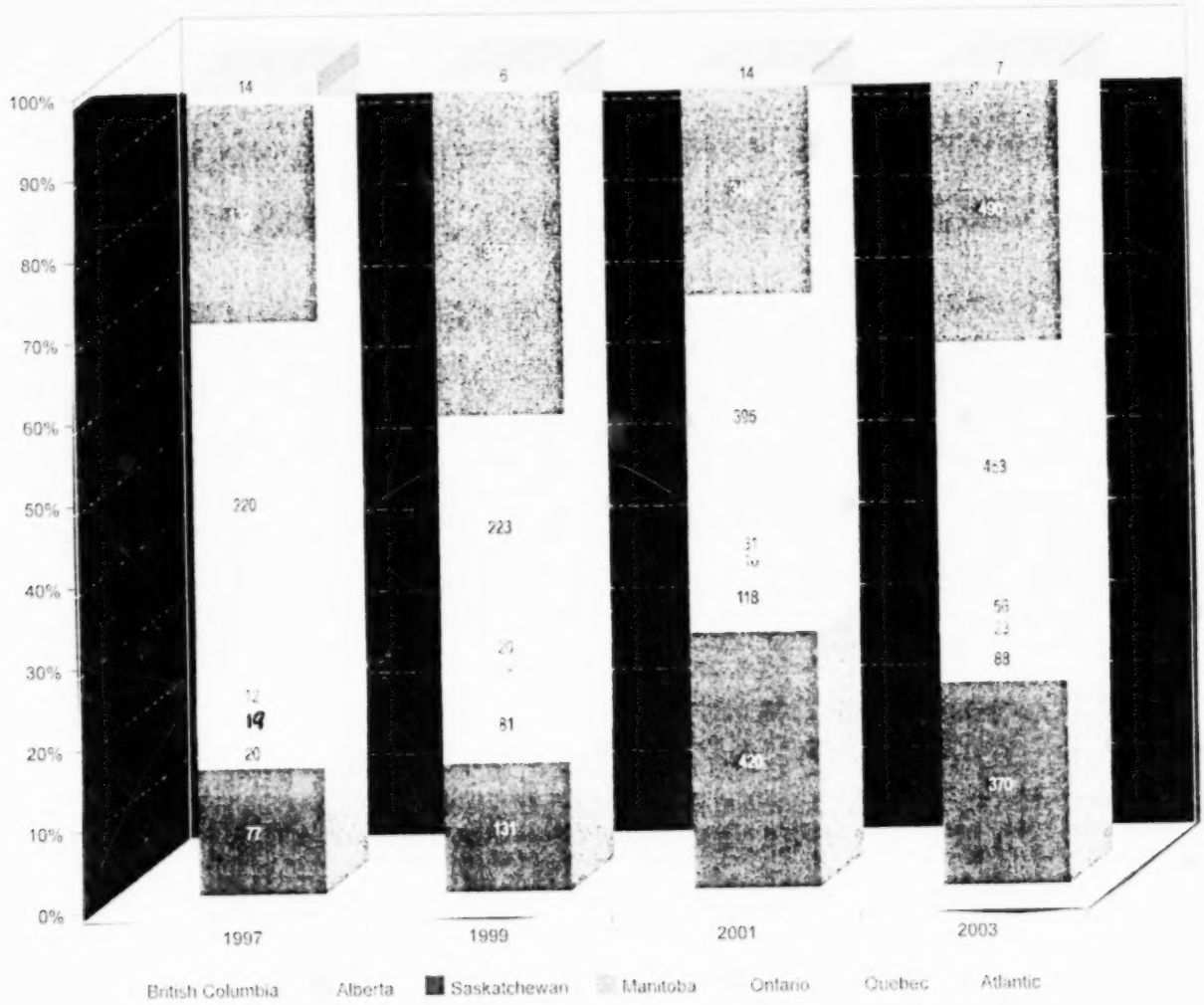
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Table 9
Changes in biotechnology R&D expenditures of innovative biotechnology firms, by size, sector and province, 1997 to 2003

	Biotechnology R&D Expenditures (Millions of Dollars)				Biotechnology R&D Expenditures as a Percentage of Total R&D Expenditures (%)			
	1997	1999	2001	2003	1997	1999	2001	2003
A) SIZE								
Small	193	256	433	495	63	87	67	65
Medium	124	106	601	699	73	58	87	87
Large	177	465	303	293	40	63	34	40
Total	494	827	1,337	1,487	53	68	60	65
B) SECTOR								
Human Health	409	703	1,177	1,316	56	77	78	70
Agriculture and Food Processing	53	73	107	89	57	59	34	36
Environment	10	X	16	37[1]	24	X	5	X
Other	22	X	37	46[1]	39	X	41	X
Total	494	827	1,337	1,487	53	68	60	65
C) PROVINCE								
British Columbia	77	131	420	370	88	83	73	92
Alberta	20	81	118	88	71	79	99	26
Saskatchewan	19	28	10	23	54	65	24	70
Manitoba	12	20	31	56[1]	86	65	94	90
Ontario	220	223	395	453	60	53	69	58
Quebec	132	337	349	490	34	75	39	74
Atlantic	14	6	14	7	100	100	93	70
Total	494	827	1,337	1,487	53	68	60	65

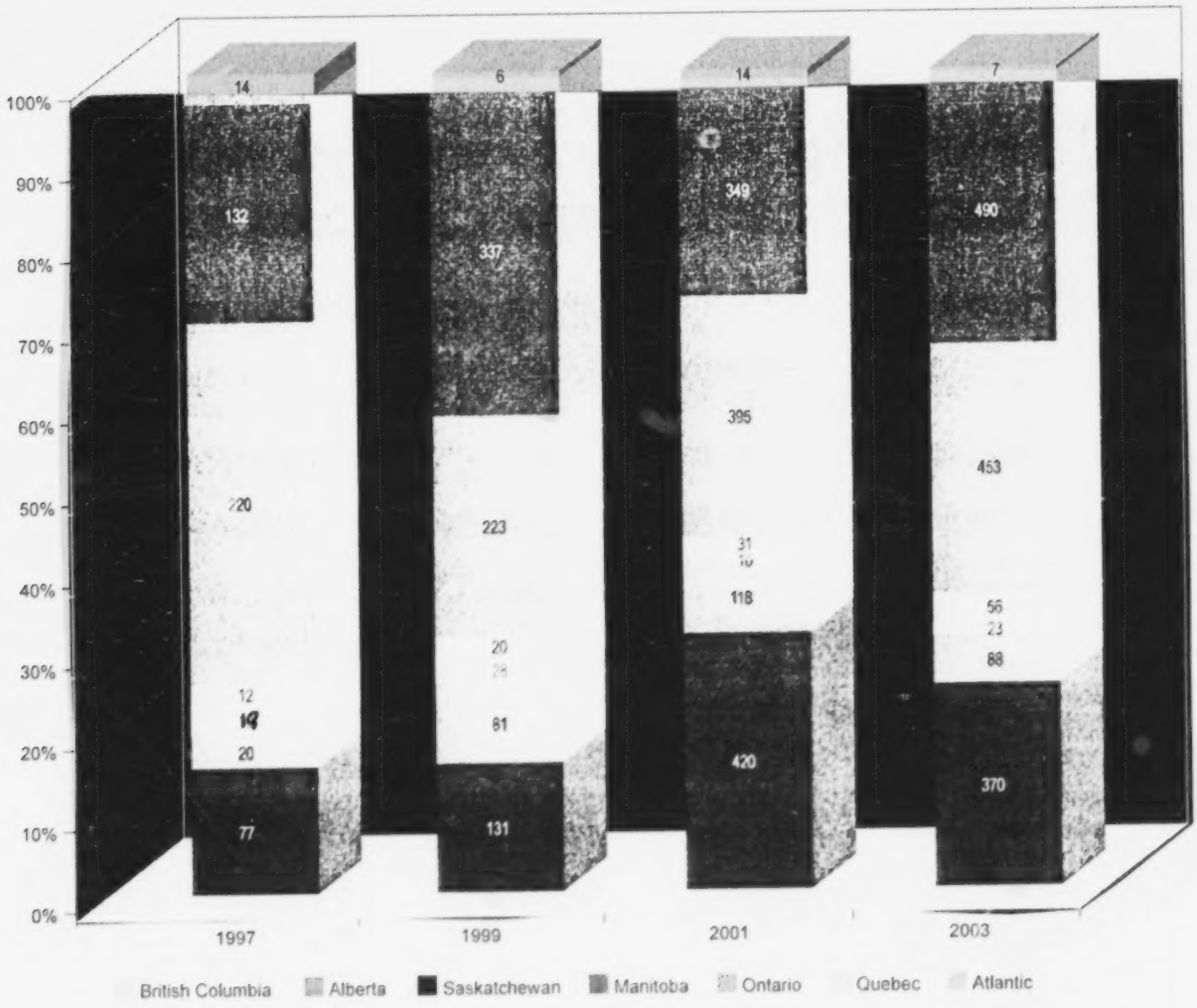
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

Figure 14
Distribution of biotechnology R&D expenditures of innovative biotechnology firms, by province, 1997 to 2003



Sources: Statistics Canada, *Biotechnology Use and Development Survey – 1997, 1999, 2001 and 2003*.

Figure 14
Distribution of biotechnology R&D expenditures of innovative biotechnology firms, by province, 1997 to 2003



Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

2.3 EXPORTS AND IMPORTS

2.3.1 Exports

- From 1997 to 2003, the revenues that innovative biotechnology companies generated from biotechnology exports nearly tripled, from $311 million to $882 million.
- In contrast, these firms' total export revenues from all sources declined from 1997 to 2001 and over the entire period 1997 to 2003, they fell from $3.3 billion to $1 billion.
- In 1997, innovative biotechnology firms' export revenues from biotechnology accounted for only 9% of their total export revenues. By 2003, the proportion was 84%. If this trend continues, biotechnology exports could eventually represent 100% of these firms' total exports.

  Large firms, firms in the Human Health sector, and firms in Quebec and Ontario are behind this trend, since biotechnology exports account for at least 90% of total exports by these companies.
- The decline in exports in the Agriculture and Food Processing sector between 2001 and 2003 was attributable to its Food Processing component, because biotechnology exports by firms in its other component, Agriculture Biotechnology, actually tripled, rising from $15 million in 2001 to $46 million in 2003. In 2001, Agriculture Biotechnology firms had projected that their biotechnology exports would increase to $53 million by 2004. As of 2003, the expected increase over 2001 seems to have been confirmed.

  In 2001, Food Processing biotechnology firms had forecast that their biotechnology exports would drop from $417 million that year to $196 million in 2004. In 2003, the decline in exports relative to 2001 was greater than had been forecasted. The reasons for this decline were that certain companies that were in this group in 2001 moved to another group in 2003, while other companies that were exporting in 2001 either had stopped exporting in 2003 or exported less that year.

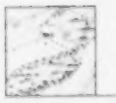


Table 10
Changes in biotechnology export revenues and total export revenues of innovative biotechnology firms, by size, sector, and province, 1997 to 2003

	Biotechnology Exports (Millions of Dollars)				Total Exports (Millions of Dollars)			
	1997	1999	2001	2003	1997	1999	2001	2003
A) SIZE								
Small	67	78	99	126	810	150	110	176
Medium	77	51	96	86	183	131	220	144
Large	167	589	551	669	2,338	2,249	1,286	727
Total	311	718	746	882	3,331	2,530	1,616	1,048
B) SECTOR								
Human Health	177	410	280	727	484	578	929[E]	734
Agriculture and Food Processing	101	284	432[E]	68	2,073	1,433	645[E]	172
Environment	24	X	28	X	750	X	35	X
Other	9	X	6	X	24	X	7	X
Total	311	718	746	882	3,331	2,530	1,616	1,048
C) PROVINCE								
British Columbia	24	60	24	F	26	290	25	F
Alberta	49	X	F	24[E]	52	101	F	40[E]
Saskatchewan	2	208	5	9	441	763	66[E]	82
Manitoba	2	43	X	F	1,130	53	X	F
Ontario	153	164	63	94[E]	540	709	79	105[E]
Quebec	59	227	591[E]	187[E]	1,116	612	1,272[E]	203[E]
Atlantic	22	X	2	15[E]	26	2	5	60[E]
Total	311	718	746	882	3,331	2,530	1,616	1,048

Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

- Biotechnology export revenues as a proportion of innovative biotechnology firms' total biotechnology revenues fell from 38% in 1997 to 21% in 2001, but rose slightly in 2003. A larger share of these firms' biotechnology revenues is attributed to biotechnology exports in 2003 (23%) compared to 2001.

  Medium-sized firms were the only size group that generated a smaller share of their biotechnology revenues from exports in 2003. Their biotechnology export revenues as a percentage of their total biotechnology revenues fell from 38% in 1997 to only 9% in 2003.

2.3.2 Imports

- From 1999 to 2003, total import expenditures by innovative biotechnology companies increased more than six-fold, from $258 million to $1.8 billion.
- Biotechnology firms in the Human Health sector accounted for most of these total import expenditures: nearly 80% in 1999, 93% in 2001 and 97% in 2003.
- In 2001, companies in Quebec accounted for 66% of these total import expenditures, but by 2003, imports by Quebec firms had fallen back to their 1999 level and accounted for 1% of the total. The reason for this decline was that as in 2003, some companies had stopped importing, while others that had accounted for a significant share of imports in 2001 no longer existed, or had merged with other firms, or had moved their activities abroad.

  Ontario companies took over the lead in 2003, accounting for 97% of total import expenditures.
- Overall, imports of biotechnology products by innovative biotechnology firms grew by 80% from 1999 to 2003, but there was a relatively small decline (-3%) from 2001 to 2003.

  Though biotechnology imports by innovative biotechnology firms fell from 2001 to 2003 overall, they increased by 4% in the Human Health sector, which accounts for at least 80% of all biotechnology imports every year.

Table 11

Changes in biotechnology import expenditures and total import expenditures of innovative biotechnology firms, by size, sector, and province, 1999 to 2003

	Biotechnology Imports (Millions of Dollars)			Total Imports (Millions of Dollars)		
	1999	2001	2003	1999	2001	2003
A) SIZE						
Small	31	17	31	38	27	37
Medium	70	136	X	76	268	X
Large	133	280[E]	F	144	1,177[E]	F
Total	234	433	422	258	1,472	1,797[E]
B) SECTOR						
Human Health	185	365	379[E]	204	1,368	1,742[E]
Agriculture and Food Processing	48	X	F	50	X	F
Environment	..	59[E]	F	1	59[E]	5
Other	..	..	X	3	..	X
Total	234	433	422	258	1,472	1,797[E]
C) PROVINCE						
British Columbia	26	F	10	33	F	11
Alberta	..	..	F	1	..	F
Saskatchewan	..	..	0	..	..	0
Manitoba	10	F	10[E]	12	F	10[E]
Ontario	172	121	381[E]	183	271	1,749[E]
Quebec	26	243[E]	15[E]	29	976[E]	17[E]
Atlantic	..	..	F	..	..	F
Total	234	433	422	258	1,472	1,797[E]

Note: No information on imports is available for 1997, because the respondents were not asked this question.
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1999, 2001, 2003.

2.4 CAPITAL FINANCING

2.4.1 Raising Capital

Among the 490 innovative biotechnology firms surveyed in 2003, 254 had attempted to raise financing capital, and 178 of them had succeeded in doing so. More than half (53%) of the firms that did raise capital met their financing target.

Table 12
Raising of capital by innovative biotechnology firms, by size, sector, and province, 2003

	Innovative Biotechnology Firms			
	Total Number	*Number That Attempted To Raise Capital*	*Number That Succeeded*	*Number That Met Financing Target*
A) SIZE				
Small	352	209	139	68
Medium	77	32	29	20
Large	61	13	10	7
Total	490	254	178	94
B) SECTOR				
Human Health	262	170	130	72
Agriculture and Food Processing	137	45	26	14
Environment and Other	90	38	22[F]	8[F]
Total	490	254	178	94
C) PROVINCE				
British Columbia	91	46	30	19
Alberta	44	22	16	13
Saskatchewan	34	16	6	X
Manitoba	21	8	6	5
Ontario	129	63	46	21
Quebec	146	83	63	30
Atlantic	25	16	10	X
Total	490	254	178	94

Note: To protect confidentiality, we have combined the "Environment" and "Other" sectors in this table.
Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

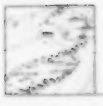


Table 13
Raising of capital by innovative biotechnology firms, by size, sector, and province, 2001

	Innovative Biotechnology Firms			
	Total Number	Number That Attempted To Raise Capital	Number That Succeeded	Number That Met Financing Target
A) SIZE				
Small	267	156	109	56
Medium	62	23	16	13
Large	46	9	9	6
Total	375	188	134	74
B) SECTOR				
Human Health	197	126	94	50
Agriculture and Food Processing	113	39	29	16
Environment and Other	65	23	11	8
Total	375	188	134	74
C) PROVINCE				
British Columbia	69	26	22	12
Alberta	24	12	12	6
Saskatchewan	17	X	X	X
Manitoba	11	X	X	X
Ontario	101	56	34	19
Quebec	130	72	53	34
Atlantic	23	12	7	X
Total	375	188	134	74

Note: To protect confidentiality, we have combined the "Environment" and "Other" sectors in this table.
Source: Statistics Canada, *Biotechnology Use and Development Survey – 2001*.

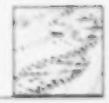
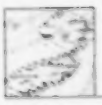


Table 14
Raising of capital by innovative biotechnology firms, by size, sector, and province, 1999

	Innovative Biotechnology Firms			
	Total Number	Number That Attempted To Raise Capital	Number That Succeeded	Number That Met Financing Target[2]
A) SIZE				
Small	270	149	119	..
Medium	51	24	15	..
Large	37	5	5	..
Total	358	178	138	..
B) SECTOR				
Human Health	150	104	84	..
Agriculture and Food Processing	119	43	34	..
Environment and Other[1]	89	31	20	..
Total	358	178	138	..
C) PROVINCE				
British Columbia	71	43	33	..
Alberta	28	14	9	..
Saskatchewan	16	X	X	..
Manitoba	6	X	X	..
Ontario	111	45	39	..
Quebec	107	62	48	..
Atlantic	19	X	X	..
Total	358	178	138	..

Note 1: To protect confidentiality, we have combined the "Environment" and "Other" sectors in this table.
Note 2: The data on the number of firms that met their financing targets are not available for 1999, because this question was not asked for this reference year.
Source: Statistics Canada, *Biotechnology Use and Development Survey – 1999*.



2.4.2 Amount of Capital Raised

- Overall, in 2003, innovative biotechnology firms raised nearly $1.7 billion in capital to finance biotechnology activities, for an average of $9.5 million per firm.

  This was a very fruitful year for these firms compared with 2001, when only 134 out of the total of 375 succeeded in raising $980 million in capital. On the other hand, 2003 was less fruitful than 1999, when 138 out of 358 raised over $2 billion.

- In every year of the survey, small firms have raised more financing capital than firms in the other size categories. However, small firms seem to have more trouble in meeting their capital targets. In 2003, only 49% of small firms met their targets, compared with 69% of medium-sized firms and 70% of large ones.

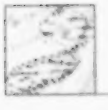
- In 2003, most of the financing capital raised by biotechnology firms–over $1 billion–was raised by firms in the Human Health sector. In second place were firms in the Agriculture and Food Processing sector, which raised $150 million. A similar pattern was seen in 1997 and 2001.

- Throughout the period 1997 to 2003, Ontario, Quebec and British Columbia were the provinces whose biotechnology firms raised the most capital. Also of note is that the amount of capital raised by Alberta firms increased steadily from year to year, rising from $40 million in 1997 to $235 million in 2003, while the amount raised by firms in the Atlantic region declined steadily, from $63 million in 1999 to $11 million in 2001 and down to $3 million in 2003.

Table 15
Changes in amount of capital raised by innovative biotechnology firms, by size, sector, and province, 1997 to 2003

	Amounts of Capital Raised (Millions of Dollars)			
	1997	1999	2001	2003
A) SIZE				
Small	333	1,690[E]	517	693
Medium	87	160	374	533
Large	47	297	89	467[E]
Total	467	2,147	980	1,694
B) SECTOR				
Human Health	332	867	858	1,460
Agriculture and Food Processing	62	87	72	150
Environment and Other	74	1,193	50[E]	82[E]
Total	467	2,147	980	1,694
C) PROVINCE				
Atlantic	X	63	11[E]	3
Quebec	69	1,301[E]	467	563
Ontario	184	175	216	253
Manitoba	X	X	X	X
Saskatchewan	36	X	F	F
Alberta	40	50	139[E]	235
British Columbia	125	545	127	579
Total	467	2,147	980	1,694

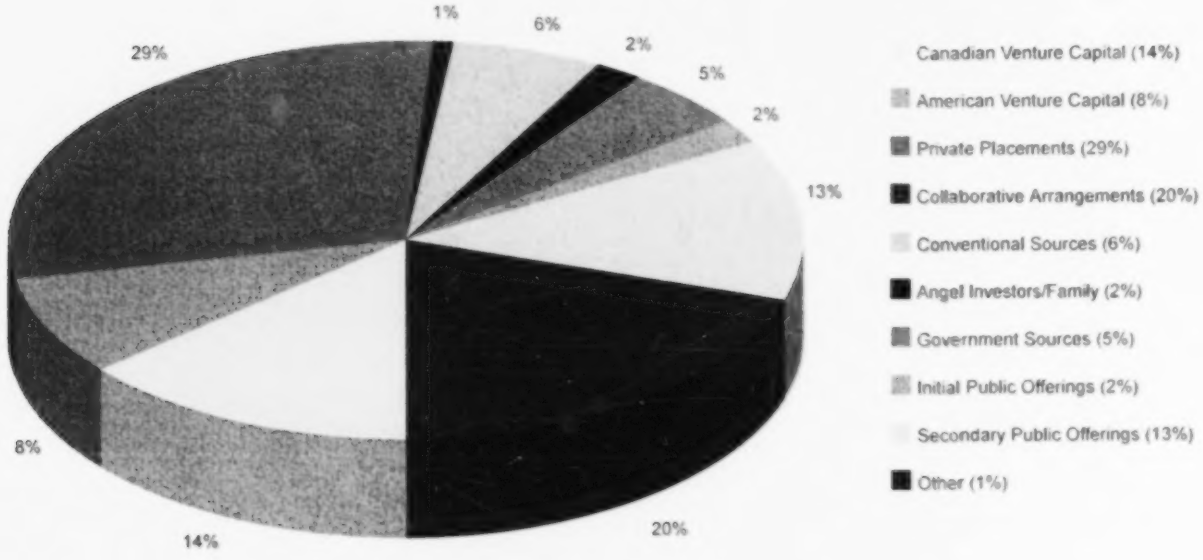
Note: To protect confidentiality, we have combined the "Environment" and "Other" sectors in this table.
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.



2.4.3 Sources of Capital

In 2003, the four main sources of capital for innovative biotechnology firms were private placements (29%), Canadian-based venture capital (14%), secondary public offerings (13%) and other sources of funding (20%).

Figure 15
Distribution of capital raised by innovative biotechnology firms, by source of financing, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

Table 16
Changes in amounts of capital raised by innovative biotechnology firms, by source of financing, 1999 to 2003

	Amounts of Capital Raised (Millions of Dollars)		
	1999	2001	2003
Total venture capital	**436**	**501**	**374**
Canadian venture capital	..	411	243
American venture capital	..	90	131
Conventional sources	**227**	**20**	**104**
Angel investors/family	**1,175**	**28**	**32**
Government sources	**26**	**49**	**87**
Private placements	..	..	**500**[2]
Initial public offerings	**54**	..	**31**[3]
Secondary public offerings	..	..	**216**
Collaborative arrangements, alliances	**10**	..	**17**
Other	**210**	**382**	**334**
Total	**2,139**	**980**	**1,694**

Note 1: These figures must be interpreted cautiously. The list of sources of financing has been modified in every year of the survey. For example, in the 1999 survey, the "Other" category consisted chiefly of private placements, but in the 2001 survey, it also included public offerings, collaborative arrangements and alliances and European-based venture capital.

Note 2: No information on the amounts of capital raised from each source of funding is available for 1997, because the related question was worded differently.

Sources: Statistics Canada, *Biotechnology Use and Development* Survey – 1999, 2001 and 2003.

2.4.4 Reasons That Lenders Limited or Refused Access to Capital

In 2003, the three main reasons that lenders gave biotechnology firms for limiting or refusing their access to capital were as follows: (1) capital was not available due to market conditions, (2) the biotechnology product or process was not sufficiently developed and (3) further development of the biotechnology product or process or proof of concept was required. These three reasons also topped the list in 2001.

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Table 17
Number of innovative biotechnology firms that were refused access to capital or had access to capital limited, by reason given by lenders, 2001 and 2003

Reasons for refusing or limiting access to capital	2001	2003
Biotechnology product/process not sufficiently developed	42	68
Biotechnology product line or portfolio limited in scope	13	17
Insufficient specific management skills/expertise	12	11
Capital not available due to market conditions	78	96
Further product development or proof of concept required	43	59
Lender does not fund development projects	28	39
Other reasons	26	33

Note: No information on the reasons for limiting or refusing access to capital is available for 1997 or 1999, because the respondents were not asked this question.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 2001* and *2003*.

2.5 TAX INCENTIVES

To encourage Canadian businesses of all sizes to conduct research and development that will lead to new or improved technologically advanced products or processes, the federal government has established the Scientific Research and Experimental Development (SR&ED) Program.[1] This program gives claimants cash refunds and/or tax credits for their expenditures on eligible research and development work done in Canada.

To qualify for the SR&ED program, work must advance the understanding of scientific relations or technologies, address scientific or technological uncertainty, and incorporate a systematic investigation by qualified personnel.

- In 2003, two out of three innovative biotechnology firms applied for tax benefits for biotechnology-related activities under the federal government's SR&ED program. In total, these firms applied for nearly $374 million in tax credits and refunds.
- On average, small firms applied for $571,000 in SR&ED tax benefits, while medium-sized firms and large firms applied for larger amounts ($2.1 million and $3.4 million, respectively).

[1] For more details on the Scientific Research and Experimental Development Program, visit the following address on the Canada Revenue Agency's Web site: www.cra-arc.gc.ca/taxcredit/sred/menu-e.html

The number of firms in the Human Health sector that applied for tax credits or refunds under the SR&ED program was greater than in any of the other biotechnology sectors: 76% of firms in this sector made such applications, compared with 54% in the Agriculture and Food Processing sector, 64% in the Environment sector, and 65% in the "Other" sector.

The average amount applied for was also higher among firms in the Human Health sector: $1.6 million, compared with $296,000 in the Agriculture and Food Processing sector, $243,000 in the Environment sector, and $472,000 in the "Other" sector.

Among all the provinces, firms in British Columbia, Manitoba and Quebec had a higher rate of participation in the SR&ED tax incentive program in 2003. In these provinces, nearly three companies out of four applied for SR&ED tax credits for biotechnology-related activities, whereas in Alberta and Saskatchewan, the percentages were only 43% and 56%, respectively. In Ontario, nearly 61% of all biotechnology firms participated in this program.

It should also be noted that the average amounts of SR&ED tax credits applied for by firms in Saskatchewan, the Atlantic provinces, and British Columbia are relatively low: $287,000, $228,000 and $925,000, respectively, compared with an average of more than $1 million in the other provinces.

In 2003, the federal government granted innovative biotechnology firms $212 million in tax credits and tax refunds for SR&ED.

Out of this total, large firms received 38% ($81 million), medium-sized firms received 34% ($73 million) and small firms received 27% ($58 million).

Most of this $212 million went to firms in the Human Health sector, which received more than $194 million, or 91% of the total. The amount received by other companies in all other biotechnology sectors combined thus totalled $18 million.

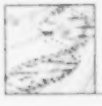

Table 18
Innovative biotechnology firms that applied for and received tax credits or tax refunds under the federal government's SR&ED program, 2003

	SR&ED Tax Credit Applications				Amount of SR&ED Tax Credits Received (Thousands of $)
	Number of Firms	Average Amount Requested (Thousands of $)	Total Amount Requested (Thousands of $)	Rate of Participation in Program (%)	
A) SIZE					
Small	237	571	135,377	67	58,184
Medium	61	2,119	129,257	79	72,869
Large	32	3,417	109,335	53	81,285
Total	330	1,133	373,969	67	212,337
B) SECTOR					
Human Health	199	1,662	330,704	76	194,128
Agriculture and Food Processing	74	296	21,870	54	9,716
Environment	22	243	5,335	58	2,942[E]
Other	34	472[E]	16,060[E]	65	5,551[E]
Total	330	1,133	373,969	67	212,337
C) PROVINCE					
British Columbia	67	925	62,005	74	34,126
Alberta	19	1,103[E]	20,951[E]	43	21,817[E]
Saskatchewan	19	287	5,462	56	3,598[E]
Manitoba	15	1,432[E]	21,487[E]	71	12,781[E]
Ontario	79	1,691	133,608	61	85,093
Quebec	114	1,110	126,588	78	53,472
Atlantic	17	228[E]	3,870[E]	68	1,451
Canada	**330**	**1,133**	**373,969**	**67**	**212,337**

Note 1: These figures should be interpreted cautiously. The amounts received in 2003 might not be associated solely with applications filed in that year. For some firms, the amount received may be associated with an application for SR&ED tax credits that was filed before 2003.

Note 2: The participation rate equals the number of innovative biotechnology firms that applied for a tax credit, as a percentage of the total number of innovative biotechnology firms.

Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

Table 18
Innovative biotechnology firms that applied for and received tax credits or tax refunds under the federal government's SR&ED program, 2003

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Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

SECTION 3
Human Resources

- Though the number of biotechnology companies and their main financial indicators have risen steadily over time, biotechnology-related employment has fluctuated fairly widely. It fell by 14% from 1997 to 1999, rose by 54% from 1999 to 2001, and then fell very slightly, by 0.2%, from 2001 to 2003. Overall, the number of employees in biotechnology-related jobs grew by 32% from 1997 to 2003.

  Innovative biotechnology firms had 11,863 employees with biotechnology-related responsibilities in 2003, representing 16% of these companies' total work force.

- The Human Health sector employed the largest share of the human resources employed in biotechnology in Canada, in all years of the survey. The Agriculture and Food Processing sector ranked second.

  Both of these sectors seem to be devoting a growing share of their total human resources to directly biotechnology-related activities. In the Human Health sector, the number of employees with biotechnology-related activities at innovative biotechnology firms, as a percentage of the total number of employees at these firms, rose from 42% in 1999 to 54% in 2001 and 58% in 2003. In the Agriculture and Food Processing sector, this figure rose from 6% in 1999 to 10% in 2001 and 14% in 2003.

  In contrast, at biotechnology companies in the Environment sector, the percentage of total human resources devoted to biotechnology-related activities has fallen, from 8% in 1999 to 3% in 2001 and 1% in 2003.

- The majority of employees with biotechnology-related responsibilities are located in three provinces: Quebec, Ontario and British Columbia. For every year of the survey, these three provinces together accounted for nearly 80% of all biotechnology employees in Canada.

  It should be noted that the number of biotechnology employees in Manitoba has increased considerably, from 209 in 1997 to 1,213 in 2003.

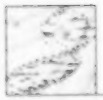


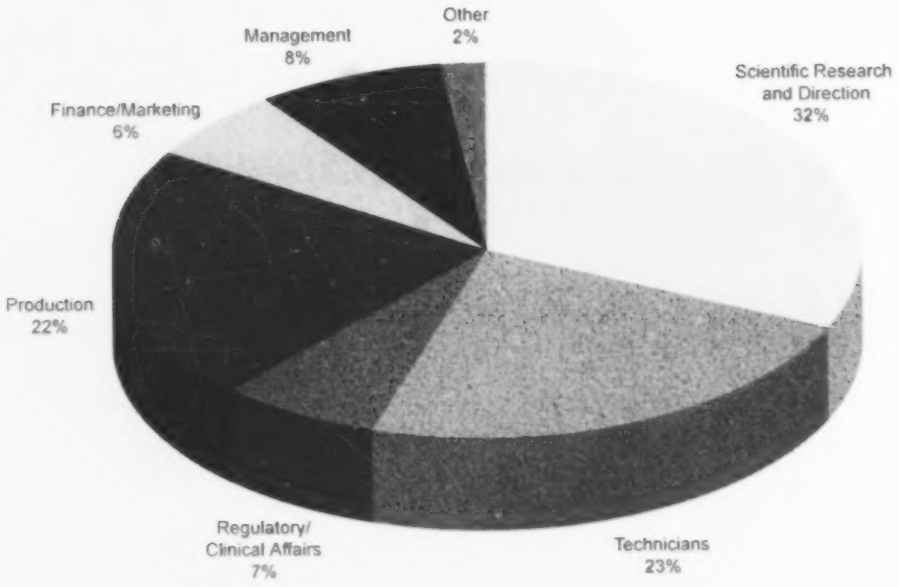
Table 19
Changes in human resources in innovative biotechnology firms, by size, sector and province, 1997 to 2003

	Number of employees with biotechnology-related responsibilities				Total number of employees			
	1997	1999	2001	2003	1997	1999	2001	2003
A) SIZE								
Small	2,895	2,902	3,144	3,619	3,470	4,907	3,910	5,184
Medium	2,299	1,323	3,230	3,746	3,514	4,673	5,268	6,416
Large	3,825	3,470	5,523	4,498	23,936	53,033	53,065	63,848
Total	9,019	7,695	11,897	11,863	30,920	62,613	62,242	75,448
B) SECTOR								
Human Health	6,280	5,433	8,675	9,255	11,383	12,945	16,145	16,069
Agriculture and Food Processing	1,542	1,323	2,264	1,832	16,436	24,037	22,332	12,684
Environment	291	323	709	246	2,074	4,187	22,689[f]	31,630[f]
Other	906	616	249	531[f]	1,027	21,514	1,076[f]	15,065[f]
Total	9,019	7,695	11,897	11,863	30,920	62,613	62,242	75,448
C) PROVINCE								
British Columbia	1,042	1,191	1,746	2,173	1,376	7,558	15,049[f]	10,042
Alberta	789	574	494	727	1,539	X	719	1,899
Saskatchewan	351	289	262	337	7,904	4,769	5,272[f]	5,423
Manitoba	209	357[f]	936[f]	1,213[f]	1,616	635	1,469	1,429[f]
Ontario	3,416	2,547	3,346	3,508	8,079	14,568	7,141	25,716
Quebec	2,722	2,557	4,710	3,700	9,672	31,060	31,054	30,094
Atlantic	490	181	402[f]	206	733	X	1,539[f]	845[f]
Total	9,019	7,695	11,897	11,863	30,920	62,613	62,242	75,448

Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

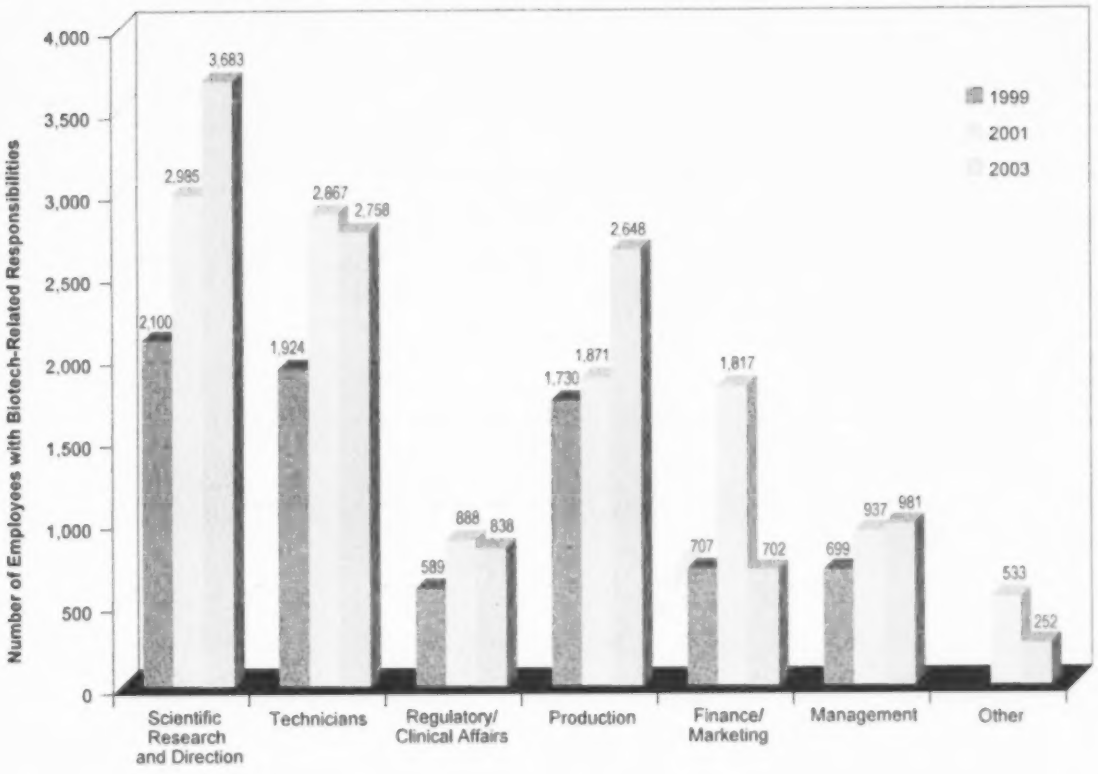
- Innovative biotechnology firms employ a high proportion of their employees in specialized positions. In 2003, more than half of these firms' employees with biotechnology-related responsibilities worked in scientific research or direction or as technicians or engineers. A similar pattern was observed in the previous years of the survey.
- The number of production employees at biotechnology firms has also increased in recent years. In 2003, it stood at 2,648, up 53% from 1999 and 42% from 2001.
- The number of finance and marketing employees involved in biotechnology-related activities has been highly volatile. It soared by 157% from 1999 to 2001, then plummeted by 61% from 2001 to 2003.

Figure 16
Distribution of biotechnology-related jobs by type, innovative biotechnology firms, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

Figure 17
Changes in number of biotechnology-related jobs by type, innovative biotechnology firms, 1999 to 2003



Note 1: The "Other" category did not exist in 1999.
Note 2: The distribution of human resources among the various functions related to biotechnology activities was different in 1997, so the information for that year is not comparable with the information for the other years of the survey.
Sources: Statistics Canada, *Biotechnology Use and Development* Survey – 1999, 2001 and 2003.

Table 20
Numbers of full-time and part-time employees assigned to biotechnology activities at innovative biotechnology firms, 1999 to 2003

	1999			2001			2003		
	Full-time	Part-time	Total	Full-time	Part-time	Total	Full-time	Part-time	Total
Scientific Research & Direction	1,891	209	2,100	2,893	92	2,985	3,488	195	3,683
Technicians	1,621	303	1,924	2,646	221	2,867	2,576	182	2,758
Regulatory/Clinical Affairs	484	105	589	833	55	888	747	91	838
Production	1,424	306	1,730	1,639	232	1,871	2,404	244	2,648
Finance/Marketing	540	167	707	1,751	66	1,817	560	142	702
Management	506	193	699	869	68	937	828	153	981
Other	..	..	..	491	43	533	237	15	252
Total	6,466	1,283	7,748	11,121	776	11,897	10,840	1,023	11,863

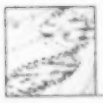
Note: No information on full-time and part-time employment is available for 1997, because the respondents were not asked this question.
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1999, 2001 and 2003.

SECTION 4
Stages of Development of Biotechnology Products and Processes

The distribution of biotechnology is not limited to any singular industry or process, but instead, biotechnology products range through a diverse set of industries and areas of interest from agricultural initiatives to human health research, to waste and environmental management.

The product pipeline[2] is a significant indicator of the future growth of a sector. Significant time and cost factors as well as a high attrition rate in bringing a single product to market characterize biotechnology. A healthy pipeline is essential for the future of biotechnology activities.

[2] The pipeline is the total number of unique products and/or processes reported by each firm and include regulated and non-regulated products and/or processes.



- In 2003 biotechnology firms reported 17,065 biotechnology products/processes at all stages[1] of development and on the market. Of these, 4,960 were in the research and development stage, and over two of three (11,046) were on the market.
- Between 1999 and 2003 the number of products at the Research and Development stage declined from 8,690 to 4,960. However, during the same time period the number of products on the market grew 68%, growing from 6,597 to 11,046.
- The Human Health sector saw the total number of products increase over 300% between 1999 and 2003, while the second largest sector, Agriculture, experienced a decline of about 13% during the same period.
- In the agriculture sector, the number of products on the market has more than doubled compared to 2001 (from 652 to 1,573) while the number of products in the regulatory phase has decreased. This increase in the number of products in the market has translated in a 92% growth in biotechnology revenues between 2001 and 2003 in the Agriculture sector.

Table 21
Number of biotechnology products/processes by development stage, 1999 to 2003

	1999	2001	2003
Research & Development	8,690	5,964	4,960
Pre-clinical trials/Confined field trials	628	732	806
Regulatory phase/Unconfined release	1,659	1,663	254
Approved/On market/In production	6,597	9,661[E]	11,046[E]
Total products/processes	17,574	18,020[E]	17,065

Note: In 1997, the question asked about biotechnology products and processes was worded differently.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 1999*, 2001 and 2003.

[1] The questionnaires used the following stages of development 1) Research & Development 2) Pre-clinical trials/Confined field trials 3) Regulatory phase/Unconfined release assessment, and 4) Approved/On market/In production.

Table 22
Number of biotechnology products/processes by firm size, sector and province, 1999 to 2003

	1999	2001	2003
A) SIZE			
Small	..	10,144	5,590
Medium	..	5,078	2,201[E]
Large	..	2,798	9,274[E]
Total	17,574	18,020	17,065
B) SECTOR			
Human Health	3,435	9,103	10,692[E]
Agriculture Biotechnology	5,557	5,926	4,813
Natural Resources	162	53	86
Environment	2,333	264	218
Aquaculture	48	X	231[E]
BioInformatics	7,249	F	404
Food Processing	785	620	622
Other	103	..	..
Total	17,574	18,020	17,065
C) PROVINCE			
British Columbia	..	1,789	2,269[E]
Alberta	..	131	242
Saskatchewan	..	167	679
Manitoba	..	2,346	85
Ontario	..	2,376	4,524
Quebec	..	11,072	8,853[E]
Atlantic	..	139	413
Total	17,574	18,020	17,065

Note: In 1997, the question asked about biotechnology products and processes was worded differently.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 1999, 2001 and 2003.*

SECTION 5
Business Practices

This section discusses the following practices that innovative biotechnology firms use to establish business relationships: forming alliances, contracting out biotechnology-related activities and providing contract services.

5.1 ALLIANCES

In the *Biotechnology Use and Development Survey*, Statistics Canada defines alliances as cooperative and collaborative arrangements as follows:

> *Cooperative and collaborative arrangements involve the active participation in projects between your company and other companies or organizations in order to develop and/or continue work on new or significantly improved biotechnology processes, products and/or services. Pure contracting-out work is not regarded as collaboration.*

The figures presented in this sub-section should be interpreted cautiously, for two reasons. First, the exact number of new alliances that were formed between any given survey and the next is hard to determine. This is due to the fact that, during this time, some new biotechnology firms will have been founded, while others that were included in the first survey may have ceased all biotechnology-related activities in Canada and hence not be included in the second survey. Secondly, in some cases, alliances that were formed between two biotechnology firms may have been reported by both of them in the same survey and thus have been double-counted in the data for that survey year.

- The majority of innovative biotechnology firms participated in at least one alliance between 1997 and 2003.
- On average, small biotechnology firms formed fewer alliances than did medium-sized and large biotechnology firms.
- Biotechnology firms in the Human Health sector were more likely to form alliances than firms in other biotechnology sectors. In 2003, the Human Health sector accounted for nearly 70% of all alliances and had a higher average number of alliances per firm than any of the other biotechnology sectors.

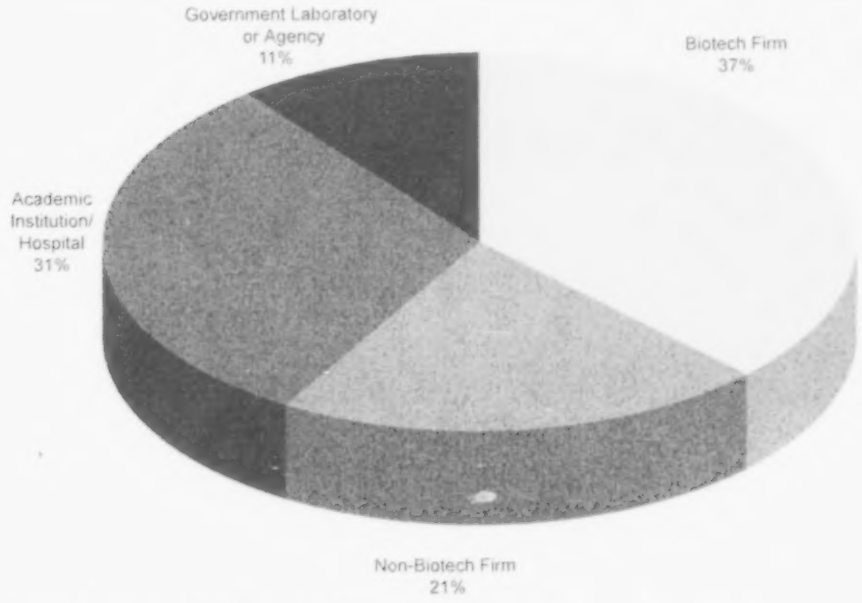
Table 23
Changes in number of alliances established by innovative biotechnology firms, by size, sector and province, 1997 to 2003

	Number of Innovative Biotechnology Firms Involved in Alliances				Average Number of Alliances Per Firm			
	1997	1999	2001	2003	1997	1999	2001	2003
A) SIZE								
Small	214	153	156	177	..	2.7	4.0	3.2
Medium	37	41	32	38	..	3.0	4.9	7.5
Large	31	30	38	36	..	5.3	9.8	5.0
Total	282	224	226	251	..	3.1	5.1	4.1
B) SECTOR								
Human Health	..	110	129	143	..	3.4	6.0	5.0
Agriculture and Food Processing	..	57	62	69	..	2.6	3.5	3.0
Environment	..	26	14	11	..	..	2.6	2.4
Other	..	31	21	27	..	..	6.2	3.0
Total	282	224	226	251	..	3.1	5.1	4.1
C) PROVINCE								
British Columbia	52	48	46	46	..	3.4	5.7	3.4
Alberta	19	24	14	28	..	2.2	3.1	2.7
Saskatchewan	19	..	9	25	..	..	3.9	3.5
Manitoba	6	..	7	8	..	..	6.0	2.1
Ontario	87	47	58	59	..	3.0	5.3	6.6
Quebec	78	79	79	71	..	3.4	5.4	3.7
Atlantic	21	13	14	14	..	1.8	2.0	2.6
Canada	**282**	**224**	**226**	**251**	..	**3.1**	**5.1**	**4.1**

Note: No information on the number of alliances per firm is available for 1997, because this question was not asked that year.
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1997, 1999, 2001 and 2003.

- Among the 1,031 alliances in which innovative biotechnology firms were involved in 2003, 37% were with other biotechnology companies, 31% with academic institutions or hospitals, 21% with non-biotechnology companies and 11% with government laboratories or agencies.

Figure 18
Alliances established by innovative biotechnology firms, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

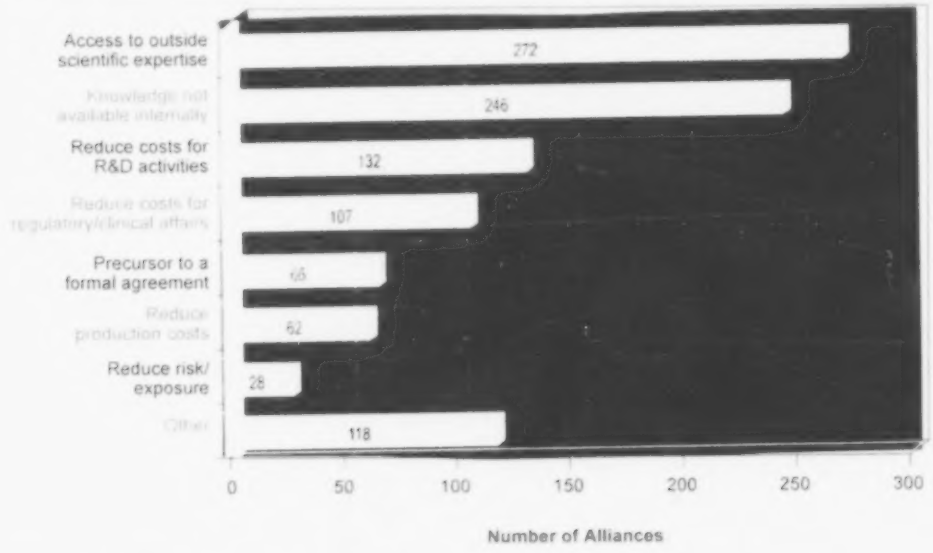
Table 24
Alliances established by innovative biotechnology firms, 1999 to 2003

	Number of Alliances		
	1999	2001	2003
Firms of same size or smaller	**156**	..	..
Larger firms	**180**	..	..
Biotechnology firms	..	**459**	**388**
Non-biotechnology firms	..	**278**	**216**
Academic institutions or hospitals	**194**	**284**	**317**
Government laboratories or agencies	**107**	**127**	**110**
Total	**638**	**1,148**	**1,031**

Note: No information on the number of alliances by partner type is available for 1997.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 1999, 2001 and 2003.*

The purposes for which innovative biotechnology companies formed alliances varied. The most common purposes were to obtain access to scientific expertise from outside the company and to obtain knowledge not available internally.

Figure 19
Alliances established by innovative biotechnology firms by purpose, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003.*

5.2 CONTRACTING OUT

- In 2003, more than half of the innovative biotechnology firms issued contracts to have other companies or agencies carry out biotechnology-related activities for them.
- From 2001 to 2003, the number of contracts issued by innovative biotechnology firms was up 54%, but the total value of these contracts seems to have decreased. This pattern held true for for all contracting out identified in the survey.

Table 25
Changes in contracting out by innovative biotechnology firms, 1999 to 2003

	Number of Firms with Contracts	Number of Contracts Issued	Total Value of Contract for Purpose of Contract (Millions of Dollars)			
			R&D	Regulatory/ Clinical	Management/ Production	Other
1999	223	..	859	103	14	8
2001	198	1,328	208	122[E]	123[E]	F
2003	254	2,051	138	73	21	F

Note: .. No information on contracting out is available for 1997, because this question was not asked in that year's survey.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 1999, 2001, 2003.*

- In 2003, innovative biotechnology firms issued 2,051 contracts to other firms or agencies for biotechnology-related activities. Among those contracts issued, $138 million were spent on research and development activities, $73 million on regulatory and clinical affairs, and $21 million on management and production.

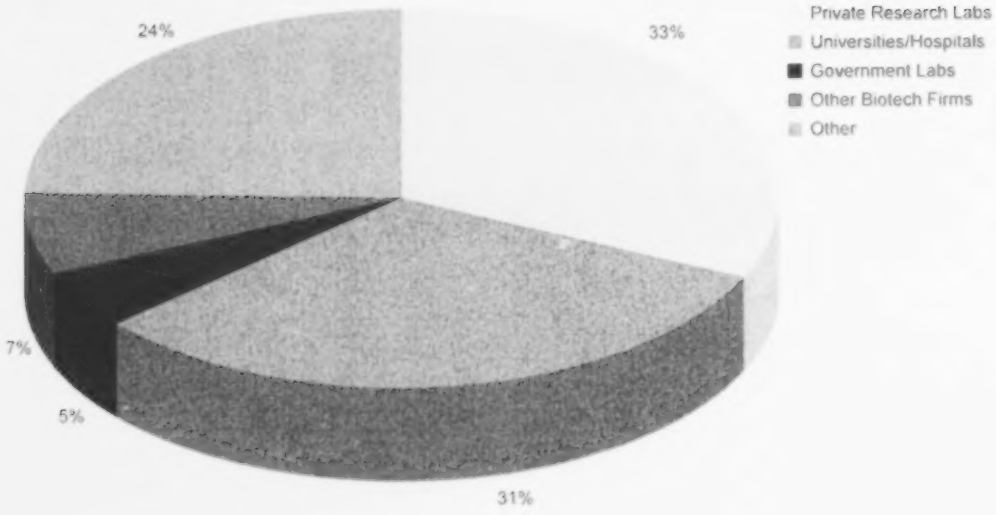
Table 26
Contracting out activities by biotechnology firms, by size, sector and province, 2003

	Number of Firms with Contracts	Number of Contracts Issued	Total Value of Contract for Purpose of Contract (Millions of Dollars)			
			R&D	Regulatory/ Clinical	Management/ Production	Other
A) SIZE						
Small	186	1,185	100,643	18,916	19,052[E]	F
Medium	43	695	29,705	17,041	1,950[E]	176
Large	25	172	7,858[E]	36,658[E]	0	F
Total	254	2,051	138,206	72,614	21,002	F
B) SECTOR						
Human Health	172	1,799	122,508	67,778	17,609[E]	F
Agriculture and Food Processing	41	152	6,025	303[E]	1,499[E]	F
Environment	15	29	515[E]	0	F	18[E]
Other	26	70	9,158[E]	4,533[E]	F	0
Total	254	2,051	138,206	72,614	21,002	F
C) PROVINCE						
British Columbia	51	537	55,430	20,297[E]	4,133	F
Alberta	25	240[E]	18,565[E]	F	462[E]	F
Saskatchewan	13	28	742[E]	F	466[E]	F
Manitoba	10	23	2,312	F	0	0
Ontario	62	531	33,864	34,245[E]	F	F
Quebec	79	667	25,609	11,538	14,338[E]	F
Atlantic	14	27	1,684	0	F	F
Total	254	2,051	138,206	72,614	21,002	F

Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

Among the 2,051 contracts issued by innovative biotechnology firms in 2003, one-third were issued to private research laboratories, nearly one-third to universities and hospitals, and the remaining third to government laboratories, other biotechnology companies and other types of partners.

Figure 20
Distribution of contracts issued by innovative biotechnology firms, by partner type, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

5.3 PROVIDING CONTRACT SERVICES

- One-quarter of all innovative biotechnology firms in Canada provided biotechnology-related services under contracts to other companies or agencies in 2001 and 2003.
- From 2001 to 2003, the revenues that these firms received from providing such services nearly tripled, from $166 million to $459 million, even though the number of contracts involved fell by more than two-thirds.

Table 27
Contracts for services provided by innovative biotechnology firms, by size, sector and province, 2001 and 2003

	2001			2003		
	Number of Contracts for Services	Number of Contracts Entered	Revenue Received ($'000,000')	Number of Contracts for Services	Number of Contracts Entered	Revenue Received ($'000,000')
A) SIZE						
Small	64	1,297	16	92	859	183
Medium	16	X	74[1]	20	325[1]	53
Large	12	F	76	21	103[1]	223[1]
Total	92	3,726	166	133	1,287	459
B) SECTOR						
Human Health	59	1,503	154	64	678	249
Agriculture and Food Processing	X	X	X	38	225[1]	130[1]
Environment	5	36[1]	1[1]	8	21	10[1]
Other	X	X	X	23	924	70[1]
Total	92	3,726	166	133	1,287	459
C) PROVINCE						
British Columbia	15	332	F	29	424	34[1]
Alberta	7	27	4[1]	15	50	4
Saskatchewan	X	F	5[1]	15	19	50[1]
Manitoba	X	X	X	X	8[1]	F
Ontario	22	444	11	28	375	88
Quebec	36	970	57	38	402	158[1]
Atlantic	6	17	F	X	9[1]	X
Total	92	3,726	166	133	1,287	459

Note: No information on contractual services is available for 1997 or 1999, because this question was not asked in the surveys for those years.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 2001 and 2003*.

- Small firms accounted for the largest proportion of these contracts in 2003 (67%). The average revenue that these firms earned per contract was $213,038: lower than the $2,170,959 average for large firms but higher than the $163,077 average for medium-sized ones.
- Firms in the Human Health sector accounted for half of total service contracts entered into by innovative biotechnology firms in 2003 and earned $249 million in revenues from this source.

  Firms in the Agriculture and Food Processing sector accounted for only 17% of all contracts entered into with other companies or agencies for biotechnology-related activities. Nevertheless, firms in this sector earned over $130 million in revenues from these contracts, or 28% of the total revenues that innovative biotechnology firms received for providing contract services.
- In 2003, companies in British Columbia accounted for the largest number of service contracts (424), followed by Quebec (402) and Ontario (375). Revenues earned under these contracts in these three provinces totalled $280 million.
- Of the 1,287 service contracts entered into by innovative biotechnology firms in 2003, 37% were with other biotechnology firms, 26% with universities and hospitals, 15% with private research laboratories, 9% with government laboratories and 14% with other types of partners.

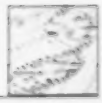
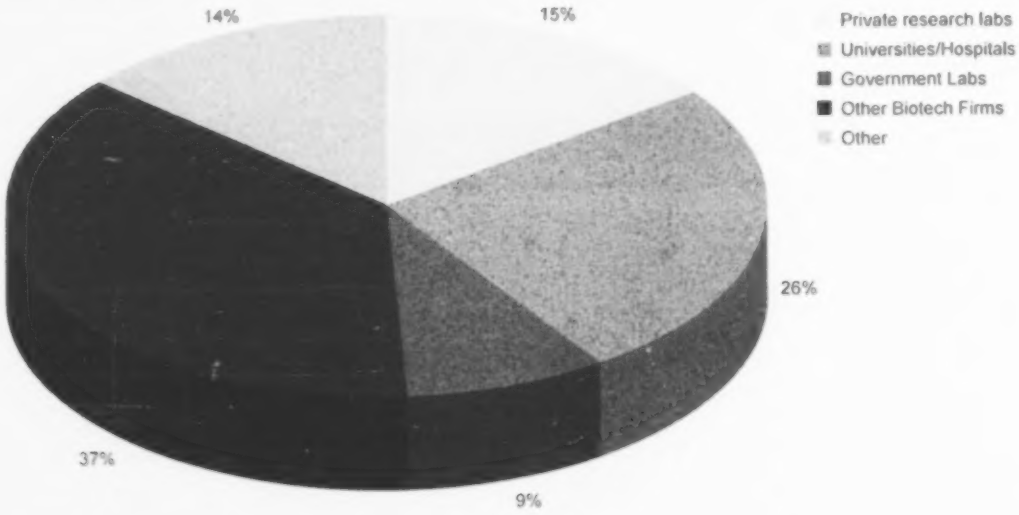


Figure 21
Distribution of contracts for innovative biotechnology firms to provide services, by type of partner, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

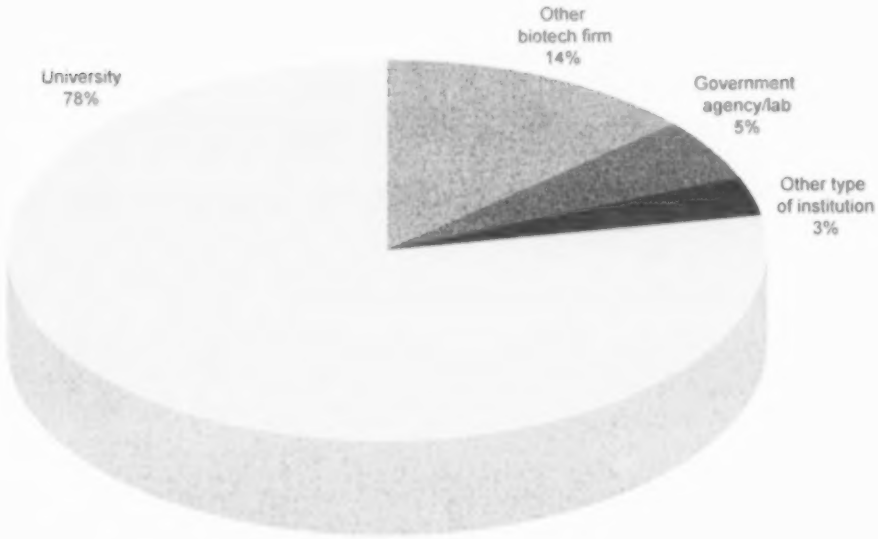
SECTION 6
Spin-Off Firms

In the 1999, 2001 and 2003 editions of the *Biotechnology Use and Development Survey*, Statistics Canada defined a **spin-off** as follows: "a new firm created to transfer and commercialize inventions and technology developed in universities, firms or laboratories."

The overall pattern regarding biotechnology firms created as spin-offs has been similar in every year of the survey.

- Almost one-third of all innovative biotechnology firms were originally created as spin-offs, most of them from universities.

Figure 22
Distribution of biotechnology spin-off firms by source of spin-off, 2003



Source: Statistics Canada, *Biotechnology Use and Development Survey – 2003*.

Table 28
Number of biotechnology spin-off firms, by source of spin-off, 1999 to 2003

	1999	2001	2003
Universities	106	102	136
Biotechnology firms	..	22	24
Other firms	12	X	X
Government labs or agencies	12	14	9
Other	3	X	X
Total	123	141	175

Note: No information on the number of spin-off companies is available for 1997, because the question on this subject was not asked in that year's survey.
Sources: Statistics Canada, *Biotechnology Use and Development Survey – 1999, 2001, 2003*.

The creation of spin-offs is associated chiefly with small firms. They account for the majority of all biotechnology spin-offs, whereas medium-sized and large firms account for less than 20% combined.

The number of spin-off biotechnology firms as a percentage of all biotechnology firms also varies substantially from one size category to another. In 2003, for example, 43% of all small biotechnology firms were spin-offs, but only 27% of all medium-sized biotechnology firms and only 6% of all large ones.

The largest number of biotechnology spin-offs is in the Human Health sector, with the Agriculture and Food Processing sector a distant second.

Also noteworthy is that nearly half of all companies in the Human Health sector are spin-offs. A closer analysis of the sectors grouped in the "Other" category shows that in 2003, half of all innovative biotechnology firms in the Bioinformatics sector were spin-offs, while the percentages in the Aquaculture and Natural Resources sectors were lower.

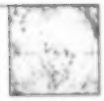
Quebec, Ontario and British Columbia are the three provinces with the largest numbers of spin-off biotechnology firms. Also, Alberta and British Columbia are the two provinces where spin-offs account for the highest proportion of the total number of innovative biotechnology firms.

Table 29
Number of spin-offs among innovative biotechnology firms, by size, sector, and province, 1999 to 2003

	1999	2001	2003
A) SIZE			
Small	112	117	151
Medium	6	18	21
Large	5	6	4[F]
Total	123	140	175
B) SECTOR			
Human Health	75	98	123
Agriculture and Food Processing	28	26	29
Environment	X	7	5[F]
Other	X	9	19[F]
Total	123	140	175
C) PROVINCE			
British Columbia	31	33	38
Alberta	..	16	22
Saskatchewan	..	6	8
Manitoba	..	4	6
Ontario	30	28	40
Quebec	33	48	54
Atlantic	..	5	8
Total	123	140	175

Note: No information on the number of spin-offs is available for 1997, because the question on this subject was not asked in that year's survey.
Sources: Statistics Canada, *Biotechnology Use and Development* Survey – 1999, 2001 and 2003.

3 | INTERNATIONAL COMPARISONS OF BIOTECHNOLOGY STATISTICS



Before the year 2000, there were no international conventions for measuring and comparing biotechnology activities from one country to another. However, since that year, OECD member countries have sent national experts on science and technology indicators to five annual *ad hoc* meetings on biotechnology statistics, with the goal of developing common standards for biotechnology indicators.

As a result of these meetings, both to stimulate discussion and to provide an initial look at the scant biotechnology statistics currently available, the OECD has published the following two compilations of biotechnology statistics:

- Devlin, A. 2003. *An Overview of Biotechnology Statistics in Selected Countries*, STI Working Papers 2003/13, OECD, Paris.
- Van Beuzekom, B. 2001. *Biotechnology Statistics in OECD Member Countries: Compendium of Existing National Statistics*, STI Working Papers 2001/6, OECD, Paris.

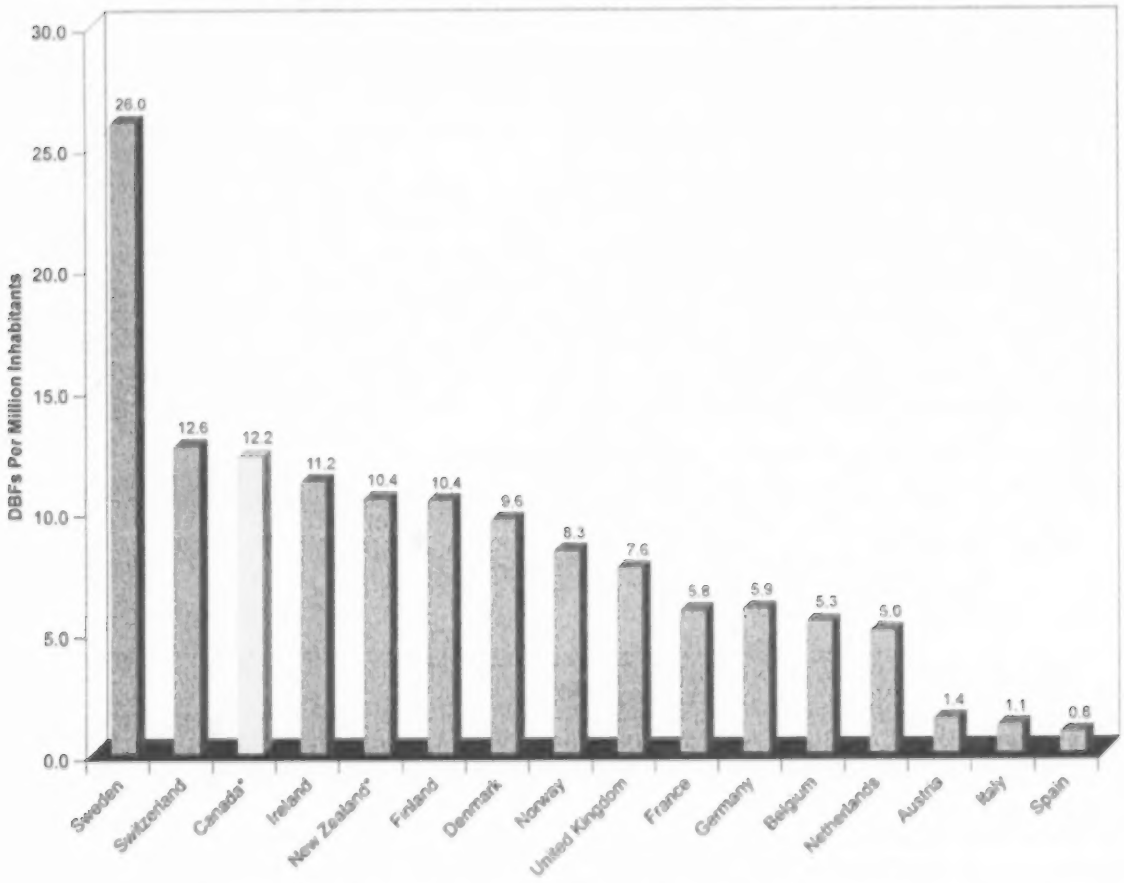
In this chapter, we present a few graphs from these two publications in order to compare Canada's biotechnology activities with those of the other member countries and observer countries of the OECD.

It is important to note that the data presented in sections 1 and 2 are not fully comparable from country to country. There are still some considerable differences in the definitions and methods that countries use to compile their data. Thus the tables and graphs give only a preliminary overview of the international comparisons.

SECTION 1
Number of Dedicated Biotechnology Firms

- The number of dedicated biotechnology firms per million inhabitants is highest in Sweden, Switzerland and Canada.

Figure 23
Dedicated biotechnology firms per million inhabitants, 2000



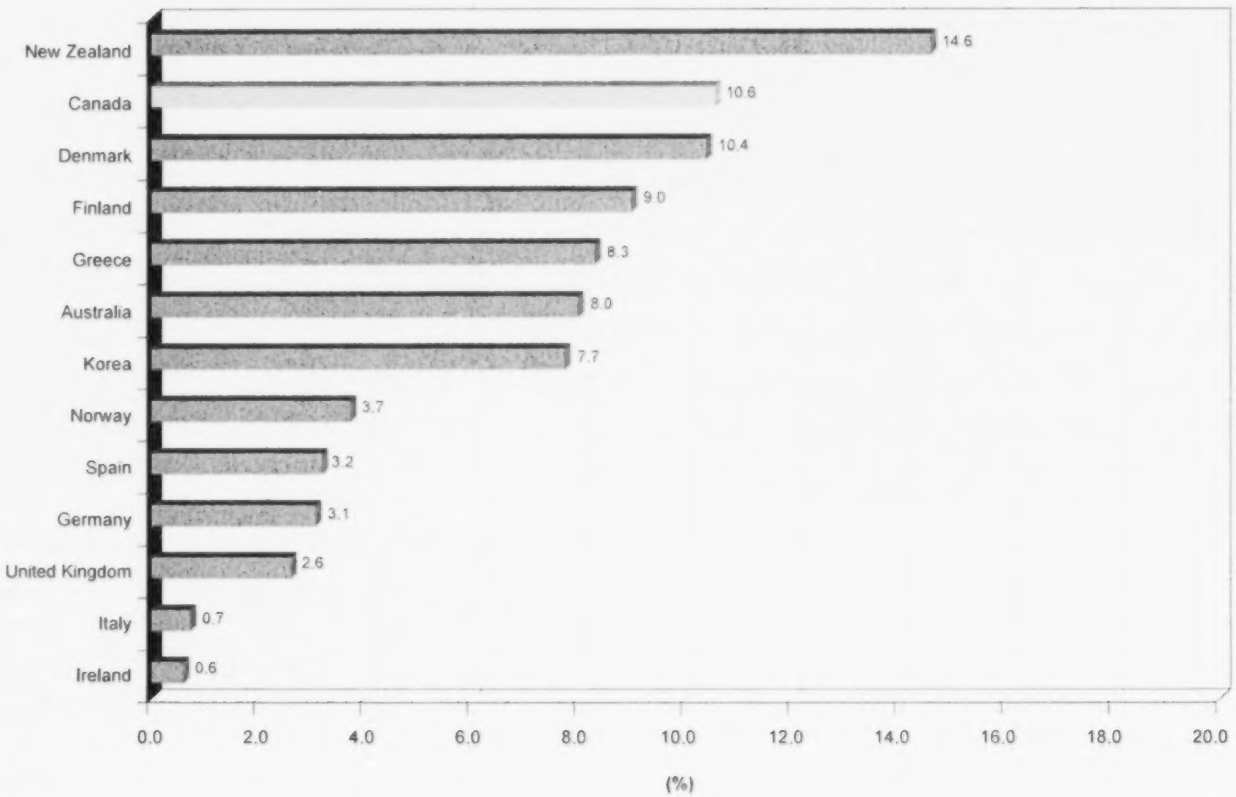
Note 1: New Zealand reports data for 1998–1999 for firms identifying at least one biotechnology process. Data from all other countries are for December 2000. Biotechnology definitions have not been harmonized across countries. Therefore, some differences may be due to definitional differences.
Note 2: The University of Siena is the source for all countries except for Canada and New Zealand.
Source: Devlin, 2003, "An Overview of Biotechnology Statistics in Selected Countries", STI Working Papers 2003/11, OECD, Paris, p. 11.

SECTION 2
Public-Sector Investment in Biotechnology Research and Development

The figures in this section must be used with caution. The definitions of research and development (R&D) used by the OECD's member countries and observer countries have varied, especially as to whether they include or exclude biotechnology R&D performed at institutions of higher learning. To compare public-sector investment in biotechnology R&D from country to country, the OECD has used "government budgetary appropriations or outlays for R&D (GBOARD) for Australia, Canada, Germany, Greece, Ireland, Italy, Korea, Spain and the United Kingdom; government-financed gross domestic expenditure on R&D (GERD) for Norway; and the sum of R&D performed by government, higher education and private non-profit sectors for Denmark, Finland and New Zealand". The United States and Japan, two countries that make massive investments in biotechnology R&D, have been excluded from the comparisons, since no data are available on the publicly funded R&D done by these two countries.

- The proportion of total publicly funded R&D investments that is devoted to biotechnology varies tremendously from one country to another. Denmark, Canada and New Zealand invest more than 10% of their total publicly funded R&D budgets in biotechnology.

Figure 24
Publicly funded biotechnology R&D as a percentage of total publicly funded R&D, 2000 or nearest available year



Source: Devlin, 2003, "An Overview of Biotechnology Statistics in Selected Countries", STI Working Papers 2003/13, OECD, Paris, p. 10.

SECTION 3
Patents

To compare the biotechnology-patent-related activities of the OECD member countries and observer countries, the OECD used data from two different sources: the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO).

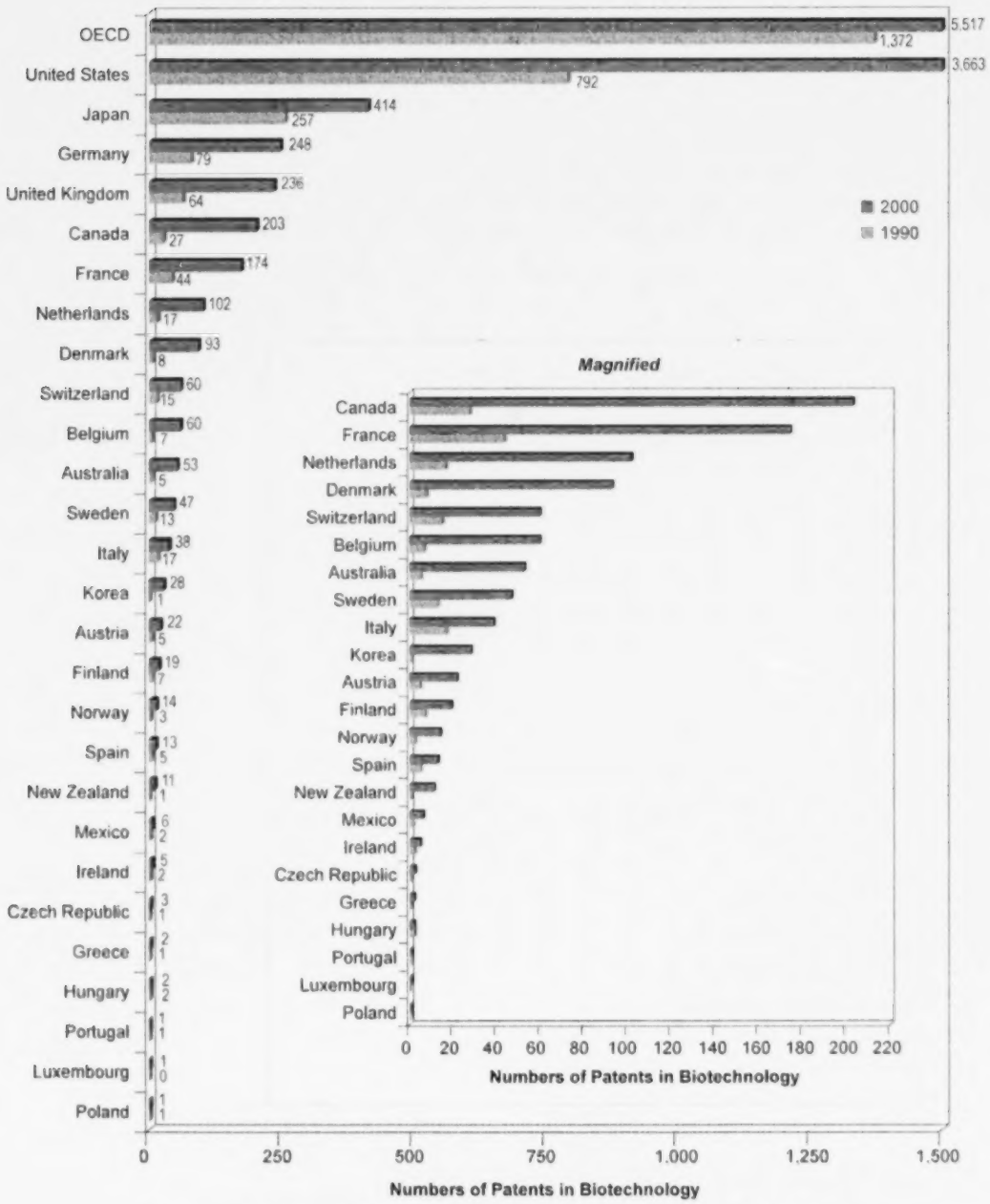
The two charts presented in this section are based on the priority date: the date of the first filing of an application for a biotechnology-related patent, worldwide. However, the data that these charts show for each country should be interpreted cautiously. The USPTO data include only those applications for which the patents were subsequently granted, whereas the EPO data include all applications, regardless of whether the patent was granted.

The countries shown in these charts represent the countries of residence of the inventors. To avoid double-counting, when a single patent is granted to several inventors from more than one country, the patent is divided up among these countries through "fractional counting".

- The number of biotechnology patent applications filed with the EPO increased significantly from 1990 to 1999, at an average rate of 10% per year.
- A similar trend was seen at the USPTO, where the number of biotechnology patents granted to OECD member countries quadrupled in 10 years, from 1,372 for 1990 to 5,517 for 2000.
- The United States accounted for the largest share of all biotechnology patent applications received by the EPO for priority year 1999 and all biotechnology patents granted by the USPTO for priority year 2000. The five countries with the next highest shares of biotechnology patents at these two patent offices are G7 countries (Japan, Germany, the United Kingdom, Canada and France), but their shares are far smaller than that of the United States.
- Canada accounted for 4% of all biotechnology patents granted by the USPTO for priority year 2000 and 3% of all biotechnology patent applications filed with the EPO for priority year 1999.

  Even though its share is small, Canada ranks third, after Korea and New Zealand, in its rate of increase in the number of biotechnology patent applications filed with the EPO for 1990 to 1999. Canada's rate of increase in number of biotechnology patents granted by the USPTO for 1990 to 2000 is also high compared with the other countries of the OECD.

Figure 25
Biotechnology patents granted by the USPTO for priority years 1990 and 2000



Source: Van Beuzekom, 2001, "Biotechnology Statistics in OECD Member Countries: Compendium of Existing National Statistics, STI Working Papers 2001/6, OECD, Paris, p. 11.